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THE FOUNDRY

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G. H. GARDNER, PRESIDENT AND TREASURER.
JOHN A. PENTON, VICE-PRESIDENT.
A. I. FINDLEY, SECRETARY.

JOHN A. PENTON, ... Editor.
HENRY HANSEN, ... Associate Editor.

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Practical articles pertaining to the trade in all its branches are solicited and will be paid for.

We can begin subscriptions with the current number only.

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Trade Outlook.

While a disposition is shown on the part of founders to avoid the placing of long time contracts at present figures, there is little indication that such action on their part will materially affect values, since furnaces appear to be glad of an opportunity to clean up on deliveries which should have been made long ago. A concerted movement on the part of the foundries to refrain from buying is of course out of the question and as long as they continue to be crowded with orders for castings, they will be forced to buy fuel and iron on the best terms they can obtain, which are not likely to be much below the present level, as long as conditions surrounding the furnaces remain as they are. The only practical way for the founder to recoup himself is to follow the course pursued by other manufacturers and let the consumer pay the increases in costs through higher prices for castings.

Just what employes connected with the foundry trade will demand in the way of increased wages or shorter hours during the first part of the year has not been clearly defined at this time, although there is no doubt that further concessions will be asked for. The nine-hour workday, conceded by many shops in the Eastern states, may be made an issue in other parts of the country, yet there is undoubtedly a large percentage of workmen who would much prefer higher wages and a chance to earn all they can while times are good. Several advances have been made in the selling price of stoves and may be made a basis for the claim that molding prices should be increased in proportion. Owing to a scarcity of competent workmen many founders find themselves compelled to pay a higher rate of wages than that demanded as a minimum a short time ago and considerable rivalry exists in certain localities between firms bidding against one another to secure their quota of help.

The Expanding Field for Foundry Equipment.

There are as yet many foundries operated exclusively by the power generated by common laborers at so much per day, and the strange part of it is that a large percentage of these are connected with manufacturing establishments, which are considered well advanced in shop practice, at least as far as other departments are concerned. The fact stands out prominently, however, that during the past few years millions of dollars have been invested in machinery for doing work in the foundry formerly done by hand. Not only are the real modern shops of to-day spending money to reduce labor costs of molding and doing work inside of their foundries, but shipping facilities and equipment for handling material and stock on the outside are receiving an unusual amount of attention, the installation of such often reducing the cost of castings several dollars per ton.

In many instances arrangements are made for railway trackage which will land stock on a level with the cupola platform

Tech 5-5

and thus avoid the employment of elevating machinery. In a general way the cramped conditions of the average charging scaffold are slowly disappearing and ways and means being devised whereby charges of fuel and iron may be deposited in the cupola with the minimum amount of labor. In other directions economies are being effected and to show that equipment along new lines is being perfected we will mention that two different parties are at the present time designing machines intended to "cut over" sand on regular molding floors, and the claim is made for these, that when completed, they will not only do a better job than can be done by hand but cut the cost of doing this work in two. The founders are gradually becoming convinced that one of the easiest ways to reduce the cost of production is to reduce the amount of muscle power they have hitherto employed so freely and in its place substitute a power having its inception at the coal pile

Loss in Remelting and the Regulation of Cupola Mixtures.

At the January meeting of the New England Foundrymen's Association, Mr. W. J. Keep discussed the best method of weighing cupola charges—whether it is better to weigh each kind of iron separately, or to place on the scale a given number of pigs of each brand of iron, beginning with the iron containing the greatest percentage of silicon and balancing the scale with the iron containing the least percentage. The author prefers the latter, and found by weighing each charge of iron by both methods that the calculated percentage of elements did not vary enough to make any difference.

If the latter method is adopted, it was recommended that the average weight of the pigs of each brand of pig iron be used, as there is considerable variation in the size of pigs from different furnaces. Using such average weights in determining how many pigs of each to use in a charge, the correct weight of each iron is obtained.

From tables containing 80 different analyses of each element, the loss or gain of these during remelting was found to be as follows:

Total carbon decreases. Whether it was more or less graphite depended upon conditions.

Silicon always decreases and the 0.20 per cent which chemists usually add to make up such loss was not considered enough; 0.25 per cent would be more safe.

Phosphorus varies slightly either way, according to conditions.

Sulphur always increases and chemists usually consider it 0.03 per cent.

Manganese always decreases.

As bearing on the loss of iron during remelting, some interesting experiments were reported. In a cupola lined to 52 inches, with coke containing 0.72 sulphur, and a wind pressure of 12 ounces, one ton of No. 1 pig iron was melted, with a loss of 95 pounds, or 4.75 per cent. By pickling a ton of pig iron, it was found that 33 pounds of the loss was sand. A ton of cleaned stove plate lost 159 pounds, or 7.95 per cent. A ton of cleaned sprues lost 130 pounds, or 6.50 per cent. A ton of stove plate not cleaned lost 230 pounds, or 11.50 per cent. A ton of sprues not cleaned lost 280 pounds, or 14 per cent. In a regular heat, with the cupola filled to the charging door, the average of two cupolas melting 20 tons each showed a loss of 88 pounds per ton, or 4.41 per cent.

The calculated loss, using the experimental data just given, was 5.80 per cent, showing the advantage of running with a cupola filled.

Another 10-ton heat in one cupola showed a loss of 4.47 per cent. This is probably the actual per cent of loss under good conditions. The coke and cinder at the bottom were picked over very carefully and no iron was thrown away. The shot iron recovered from the gangway, with a sieve having a mesh of 6 to the inch, was 26 pounds to the ton. Good molding sand recovered from the gangway and thrown back on the heaps was 111 pounds for each ton of iron melted. The coke recovered from the bottom was 57 pounds for each ton of iron melted. Of limestone, 43 pounds were used for each ton of iron. There were 207 pounds of slag drawn from the slag-hole for each ton of iron. A ton of old stove plate scrap remelted lost 227 pounds, or 11.35 per cent, and by thoroughly cleaning another ton it was found that 50 pounds of the loss was rust. For economical melting in cupolas larger than 48 inches inside, nothing is gained by breaking pig iron, but no scrap should be charged larger than a pig of iron.

No more dirt than is absolutely necessary should be put in a cupola, and the cupola should be kept full to the door.

From tables giving the physical properties and the chemical composition of quite a large number of heats, the following conclusions were drawn regarding the influence of the elements on the physical quality:

Hardness and strength are not wholly dependent upon chemical composition.

Shrinkage for any one size of test-bar decreases as silicon increases.

Carbon lowers the melting point and shrinkage, and when combined hardens cast iron.

Graphitic carbon is deposited between the crystals of iron after they are formed, and the decreased strength of such iron is on account of the loose grain.

Silicon added to white iron turns it gray, by changing combined carbon into graphite. As silicon is the only element which it is practical for the founder to use for this purpose and to decrease shrinkage, it is the controlling element.

Phosphorus does not influence carbon, but reduces strength more than any other element.

Sulphur is always present, but is of no benefit. It is sometimes freely absorbed by melted iron, and at other times, when the conditions seem the same, it will not do so.

Manganese hardens castings. Sometimes it combines with sulphur and enters the slag, but if manganese and sulphur both remain in the iron, the manganese does not counteract the influence of the sulphur. To find whether the silicon is exerting the influence that is expected, the physical quality must be measured.

The shrinkage is the only physical quality that varies with anything like uniformity with the variation of silicon. The analysis of silicon, therefore, indicates what the shrinkage should be.

Turn this the other way: The measure of shrinkage shows the influence of silicon in the presence of all other elements and conditions. This is mechanical analysis.

Mr. Keep described mechanical analysis as a quick, accurate inexpensive method of regulating the quality of castings and insisted that it would do so without any chance of a mistake. If the shrinkage continues uniform, the quality is uniform. If the shrinkage increases, silicon must be increased; if it decreases, silicon may be decreased by using irons lower in silicon.

The author favored calculating the chemical compositions of each mixture and having an analysis of silicon and sulphur furnished with each car of iron. He also favored an analysis of castings, but advised the use of mechanical analysis, whether chemical analyses were made or not.

Something of a Surprise.

At the Fort Pitt foundry of Mackintosh, Hemphill & Co., in Pittsburg, a curious thing recently happened, according to the Pittsburg *Press*, whcih states that 50 tons of melted iron found its way from a bed-plate mold to a sewer and thence to the Allegheny river, a short distance away. The curious thing about the whole business is that this was not discovered until it was sought to remove the casting, when the mold was found to be empty. Just how such a large casting could be poured and the mold remain filled for some time until feeding heads and gates were set, as must have been the case, and then spring a leak is a question.

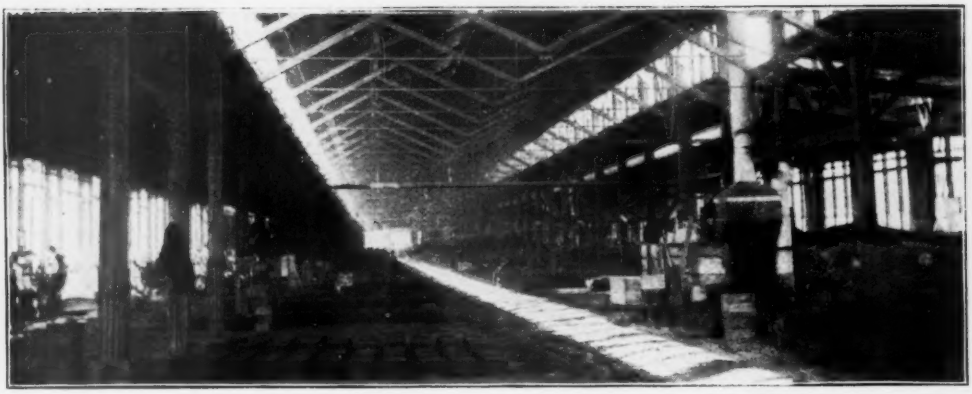
Metallurgical Section of the A. F. A.

The American Foundrymen's Association has recently organized a "Metallurgical Section.". This was undertaken in response to an increasing demand for an organization to harmonize methods employed in the analysis of iron. It is intended to take up questions connected with metallurgy in foundry and furnace work, and this division of the A. F. A. will serve as a board of exchange as it were, for those interested in the study of iron as a specialty. All furnaces, foundries, individual chemists, and independent laboratories, who would be interested in receiving more particulars concerning this section are requested to send their names to the secretary, Herbert E. Field, Ansonia, Conn.

Fires.

The foundry of Uline Bros., Ballston Spa, N. Y., burned Feb. 1st, causing a loss of $7,000. It will be rebuilt at once.

The Railway Supply Foundry Co., of Harvey, Ill., suffered the loss of its plant, Feb. 2.



A PORTION OF THE P. & O. CO.'S MALLEABLE FOUNDRY.

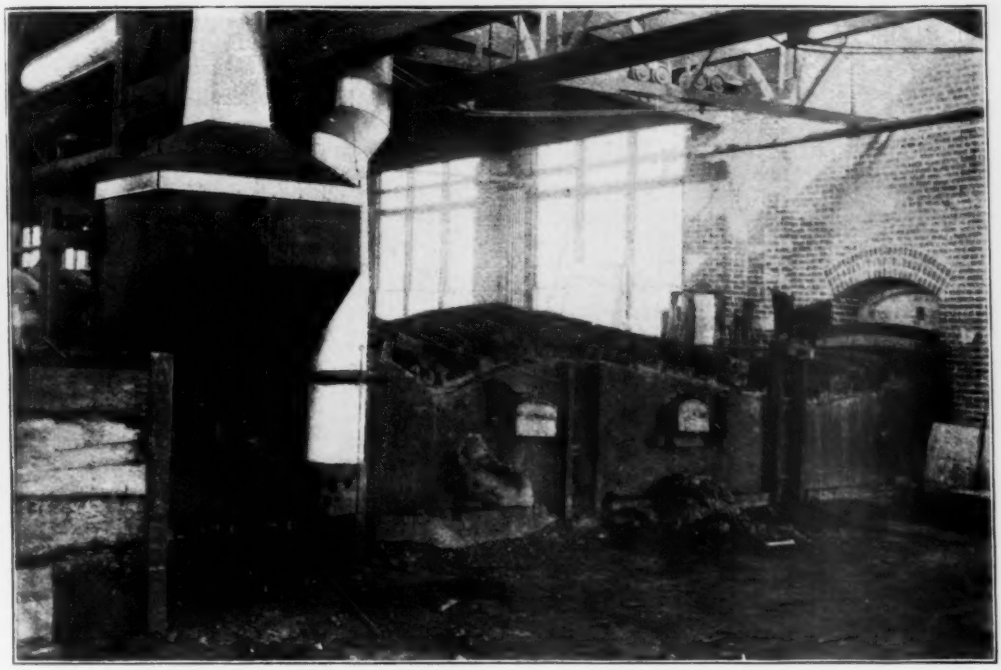
The Parlin & Orendorff Co.'s Foundries.

The broad prairies of Illinois early attracted settlers from other parts of the Union, who found the rich soil capable of yielding large crops with comparatively little labor. This state is credited with having a higher percentage of tillable area than any other, and it was here that farming on a large scale became possible. The demand for agricultural machinery naturally increased as the land came under cultivation and new implements were called for to meet conditions which did not exist in the Eastern part of the country. The development of many farming tools and much machinery of an improved character for tilling the soil is due to the manufacturers located in Illinois, and for many years the value of their product has been far ahead of what is turned out in this line by other states.

Many of the big factories for supplying the wants of the farmer which now dot Illinois had a humble beginning in the early years when railroads were unknown and transportation facilities very meagre. Farming tools and repairs for same, now obtainable in a few hours from distances hundreds of miles away, then required weeks in transit, and from this it follows that the local manufacturer at that time enjoyed a far greater monopoly in his home field than he does today.

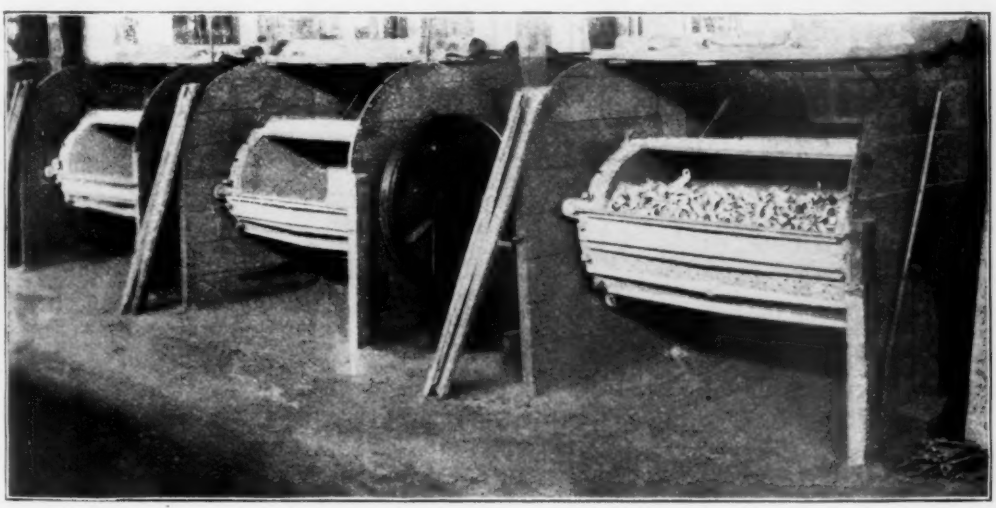
In the year 1840 William Parlin emigrated from Massachusetts to Illinois, settling where the city of Canton is now located. In 1842 he began the manufacture of plows,

PART OF THE P. & O. GRAY IRON FOUNDRY.

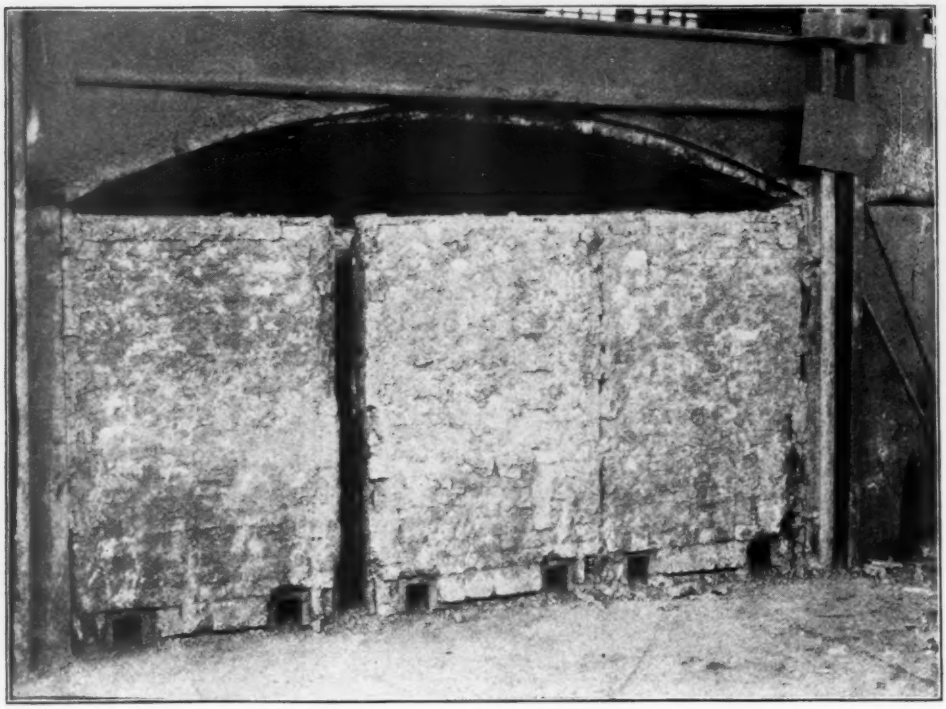


REVERBERATORY FURNACE, WITH IMPROVED FIRING FACILITIES, AT THE P. & O. CO.'S MALLEABLE FOUNDRY.

and ten years later formed a co-partnership with W. J. Orendorff, under the firm name of Parlin & Orendorff, who in 1880 were succeeded by the incorporated Parlin & Orendorff Co., of which the present officers are: Wm. H. Parlin, president, and U. G. Orendorff, secretary and treasurer, both being sons of the founders of the company. The elder Mr. Parlin died in 1892 and Mr. Orendorff in 1897. Since its inception 61 years ago the company has been continually manufacturing agricultural implements, adding from time to time new lines as the demand increased for improved machines. Not only has the Parlin & Orendorff Co. made an effort to meet domestic requirements, but

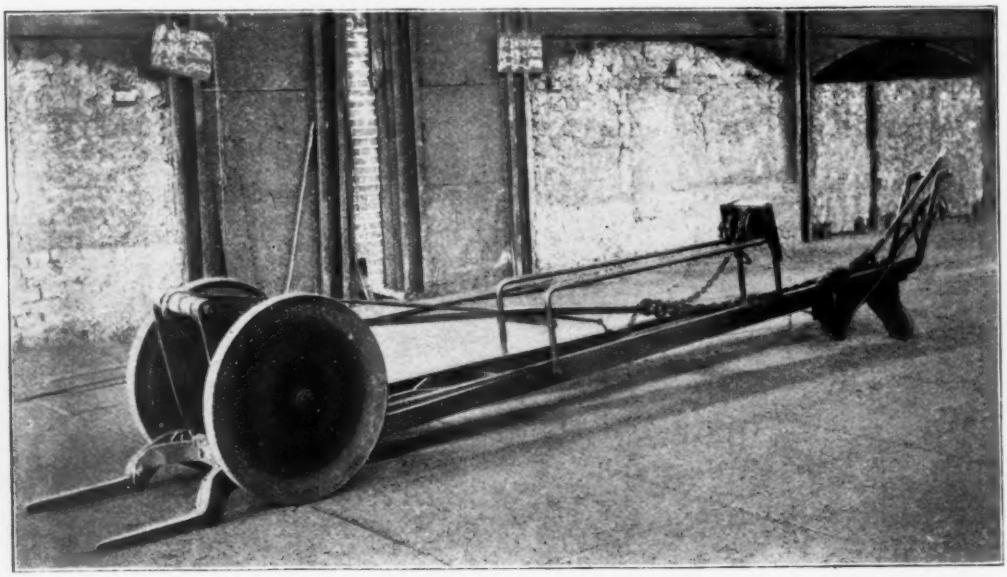


TYPE OF TUMBLING MILLS AT THE P. & O. CO.'S FOUNDRY.



METHOD OF CLOSING UP OPENINGS OF ANNEALING OVENS.

it also enjoys a large trade with the South American republics, as well as with farming communities in other parts of the world, in farming machinery designed especially for those countries. Instead of attempting to dispose of tools used at home, which could only be partly successful abroad, the company has made it a point to have its



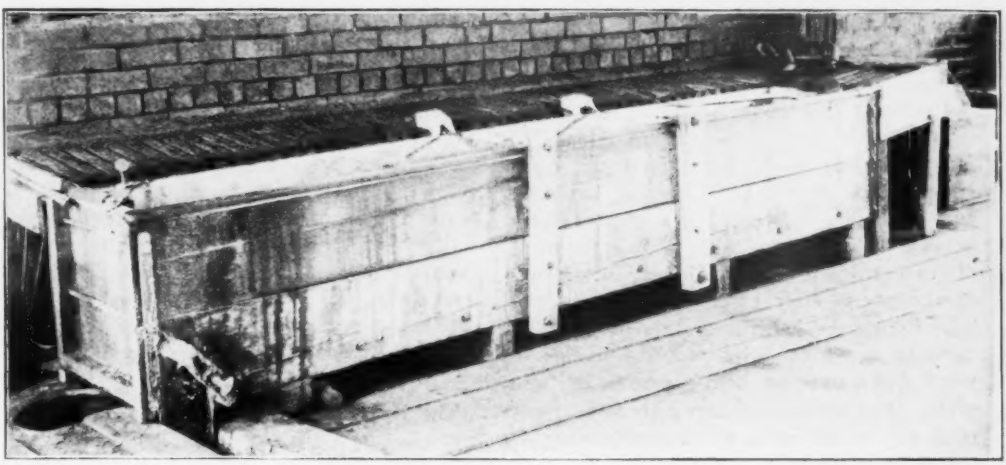
TRUCK FOR HANDLING ANNEALING POTS.

GRAY IRON FOUNDRY OF THE P. & O. CO.

representatives ascertain the peculiar conditions and necessities of other lands, a policy which has not always been followed by American manufacturers seeking to extend their trade with other nations. With one or two exceptions the product of the Parlin & Orendorff Co. is confined to implements for the preparation and cultivation of the soil. The factory buildings cover an area of 17 acres.

Like all other concerns engaged in the manufacture of agricultural implements on a large scale, the company is a heavy consumer of castings. The gray iron foundry was established many years ago, a malleable department being added some time later, in addition to which the making of chilled plow castings as well as brass castings is carried on to supply the demand for these classes of castings in the company's product. During the past year an addition 467 feet in length has been put up, which will be used for malleable iron exclusively, leaving all of the space formerly occupied by this department for gray iron, chilled and brass castings. The total length of the two foundries is 816 feet and covers the greater part of two blocks.

The variety of castings turned out may be judged when it is known that the implements manufactured require over 5,200 patterns. The majority of these are of such a character that they may be molded to the greatest advantage on the bench. A plenti-



ARRANGEMENT FOR PICKLING CASTINGS AT THE P. & O. CO.'S FOUNDRY.

ful floor space is assigned to each molder, so that stacking of molds and necessary rehandling is avoided. The foundries are provided with a large number of electric arc lights in addition to which each molder has an incandescent lamp. Handy, light, movable molding benches is the order, reducing the labor of the molder to the minimum.

The class of labor composing the 300 employes of the P. & O. Co.'s foundry is materially different from that to be found in shops in other parts of the country. The floating element, noted elsewhere among molders, is absent, and throughout the plant intelligent domestic help is the rule. Situated in the center of a prosperous farming community, and being practically the sole support of the town, the factory naturally depends upon the surrounding population for its quota of employes, and these being bound by domestic ties, do not show the tendency to change, so prominent in the workers in large cities.

By far the greater portion of the P. & O. Co.'s employes work upon the piece-work plan, and it has always been the policy of the company to permit its molders to earn good wages. They have recognized that a high output is not attained by cutting prices and that the man who has the ability to turn out good castings in fair quantity is entitled to high earnings. The superintendent, Mr. C. B. Reed, informed the writer while at the plant that several so-called "farmer boys" were earning more money per day than is paid to machinery molders in most parts of the country. Many molding machines of the squeezer type are in use, and the young men who enter the foundry seem to prefer to operate these, rather than to pound sand after the old fashion.

The annealing room adjoining the foundry contains nine ovens, a space 100x300 feet being set aside for this department, which gives plenty of room for handling and assorting castings, something badly needed in many malleable shops. Instead of tearing down and bricking up the fronts of the ovens after each batch of castings have been annealed, the greater part of this opening is covered by sections of brickwork built upon a heavy cast iron base plate. The method of using these sections is clearly indicated in the accompanying illustration, which shows that all the bricking up which has to be done is confined to the arched part of the oven and such openings as may exist between the sections. The openings in the base plates correspond to the prongs on the truck for handling annealing pots, the bottom plates of the latter containing similar openings. This truck, of which an illustration is shown, makes the removal of the annealing pots a relatively simple and inexpensive matter, and accomplishes the work connected therewith in much less time than is possible where the pots have to be placed in the ovens with the aid of small rollers and pinch bars. The capacity of an oven is therefore increased according to the rapidity with which it may be emptied and filled again. Then it should not be forgotten that a hot annealing oven is an unpleasant place to work in and with the help of the truck shown the greater part of this hard labor is avoided, and it is possible to remove the pots much earlier than where they have to be taken out by hand.

Nearly every foundry will find among its output some castings which should be pickled in order to obtain the best results. We show with this an illustration of the outfit provided for this purpose by the Parlin & Orendorff Co. This is so arranged that the castings may be readily handled and the tank emptied of acid when occasion arises to remove the sand and sediment which finds its way thereto. About forty tumbling barrels are necessary to clean the output of the foundries and the majority of these are of the friction driven type shown in the illustration. A decided departure has also been made in the construction of the reverberatory furnaces at this plant in placing the firing door at the side instead of the end of the furnace. This is plainly shown in the illustration and it will be noted that a hood is placed over this part, which frees the shop of the smoke generally to be found whenever firing takes place. Instead of the usual sliding doors, through which the iron may be puddled and skimmed, these furnaces are provided with doors, swinging in brackets, which are easily moved and when in place fit much better than the fixtures generally employed.

The Standard Scale & Foundry Co. has been organized at Kansas City, Mo., by D. M. Orcutt, A. P. Rothschild, Louis P. Rothschild and Henry C. Gumbel.

Cost Keeping in Foundries.

I am a regular reader of your magazine, and have derived much benefit from it. I would like to take up a little of your space to disagree with one of your contributors, Mr. Edward Kirk, who has an article in the February

KEYSTONE FOUNDRY CO.

Daily Record of Shop Castings.

No.....Mr.....Date.....190..

Hours	No. Pieces	Kind of Article	No. Pounds
		Patterns	
		Flasks	
		Core Pans	
		Core Boxes	
		Ladles	
		Clamps	
		Weights	
		Plates	
		Rammers	
		Machine Repairs	
		Machine Gear Wheels	
		Machine Pulleys	
		Coke Oven Castings	
		Car Castings	
		Stove Castings	
		Engine Castings	
		Furnace Castings	
		Fire Fronts	
		General Job Castings	
		Special Job Castings	
		Sheave Wheels	
		Sash Weights	
		Pipes	
		Pipe Fittings	
		Brass Work	
		National Glass Co.	
		Columns	
		Spring Seats	
		Centre Door Plates	
		Journal Boxes	
		Ratchet Wheels	
		Ratchet Pawls	
		Brake Wheels	
		P. S. C. C.	

FORM 1. MOLDERS' TIME CARD. ORIGINAL 4 X 10½ INCHES.

DAILY REPORT OF CASTINGS.

190

NAME	MADE	ARTICLE	WT. EACH	NO. CAST	DEST	NO. GOOD	WT. CAST	WT. DISCH.	WT. GOOD

FORM 2. PRODUCTION SHEET. ORIGINAL 8½ X 13 INCHES.

KEYSTONE FOUNDRY COMPANY.

TIMEKEEPER'S DAILY REPORT.

_____ 190

Foreman				
Labor in Foundry				
Labor in Core Room				
Labor on Cupola				
Moulders				
Helpers				
Outside				
Shaking Out				
Cleaning				
Chipping				
Emery Wheel				
Job Machine Work				
Machine Shop				
Shifting				
Carpenter Shop				
Patterns and Flasks				
Loading				
Other Labor				
Machine Foreman				

FORM 3. TIMEKEEPER'S REPORT. ORIGINAL 5½ X 9½ INCHES.

number on the subject of cost keeping in the foundry. I regard it as necessary to have some system of cost keeping other than that which is shown by our books at the end of six months, or one year, or whatever period may be adopted for taking stock and closing the books. For this purpose we need to have some system of keeping costs which will be accurate, and at the same time not be so elaborate as to require the time of several men to manipulate it.

DAILY FOUNDRY REPORT

Keystone Foundry Company.

....., 190..

The Heat for To-day Consists of the Following:

No ..... lbs .....
No ..... lbs .....
No ..... lbs .....
No ..... lbs .....
No ..... lbs .....
Our Own Scrap ..... lbs .....
Other Scrap ..... lbs _____
Total .....
Jobbing Castings, lbs .....
Rejected Castings, lbs .....
Remelt ..... lbs .....
Confused Scrap lbs .....
Gates ..... lbs _____
..... pounds Castings _____
No. pounds Coke .....
No. pounds Sea Coal .....
No. pounds Moulding Sand .....
No. pounds Core Sand .....
No. gallons Core Oil .....
No. pounds Chaplets .....
No. pounds Rosin .....
.....
Time required to melt heat ..... hours ..... minutes.

..... FOREMAN.

FORM 4. DAILY FOUNDRY REPORT. ORIGINAL. 5½ X 9 INCHES.

I agree with Mr. Kirk on one point;—namely, that it will not do to depend on the molders or the foreman to keep the time on different jobs, for in almost every case they will simply guess at it, and will thus leave you in worse shape than you were before, for you are probably better at guessing than they are. The writer tried this method when he first started in the foundry business, and speedily abandoned it. If you are to get any accurate data, it must be compiled by men in that line.

The method we use is to have a card made out each day by the factory clerk for each man, and these are turned in to the office early the next morning. As these cards have the different kinds of castings printed on them, it is not a great deal of trouble to do this. The timekeeper makes out his production sheet from these cards, and the report of castings is gotten from the cleaning room as soon as finished. As most of the molders work by the piece, this sheet is a necessity, and shows their time as well as the production.

The timekeeper also makes out a report each day showing the exact cost of labor in each department. This is taken from the cards on which each employe of the works records his time morning and evening by means of a Rochester time recorder. The molders' time being piece-work is taken from the production sheet named above.

The factory clerk makes out a report each day showing the iron, coke, sand and other material used. Anything not provided for on this sheet is issued on requisitions, and is thus easily accessible.

When this data is collected each day, the writer figures up the entire cost of the day's running, using a card as shown in form 5. This provides for all items of expense, and can be filled out in a short time.

In the meanwhile one of the clerks figures up the value of the day's product from the production sheet, and it is entered on another card as shown in form 6. In this way, as we know the weight of our product, we can easily get the average cost per pound, by dividing this weight into the total cost. It costs us about 50 cents per day to keep these records, and it is amply worth it. We have detected a number of leaks by having it, and if there is any part of our business that is costing us too much, it shows up at once. Moreover, you do not always want to wait until stock taking time to know how you are running, and if you have your daily records before you, you can see how things are progressing with little trouble. Of course, you know whether you are making money or losing it, (or if you do not, you will soon find out,) but it is a good thing to know where you are making your money, or if you are losing, to get some idea of how to check the loss. You cannot do this if you have no reports except those you get from your books at the end of each year.

It requires some little time to get these reports going in proper shape at the start, but if you make it a law that no work shall be

KEYSTONE FOUNDRY COMPANY

COST OF PRODUCTION_____ NO.

NO. LBS. BRASS							
" " IRON # 1							
" " " # 2							
" " SCRAP							
" " "							
" " SHOP SCRAP							
" " OTHER "							
" " REMELT							
" " REJ CAST							
TOTAL COST OF IRON							
MOULDING SAND LBS.							
CORE " "							
LIMESTONE "							
COKE "							
FACING "							
" "							
CORE OIL GAL.							
COAL " "							
MACH. " "							
FUEL							
LUMBER							
CORE ROOM							
CUPOLA							
MOULDERS							
HELPERS							
SHAKING OUT							
CLEANING							
OUTSIDE							
FOREMAN							
MACHINE SHOP							
PATTERNS & FLASKS							
FREIGHT							
AVERAGE DAILY OFFICE EXPENSE							
" " GENERAL "							
" " SALARIES							
" " INTEREST							
CASTINGS LBS.							

SHAW-WALKER MUSKEGON 7524

FORM 5. COST CARD. ORIGINAL 4 X 6 INCHES.

KEYSTONE FOUNDRY COMPANY

PRODUCTION _____ 190

Class	Article	Weight	Price	Extension	Total
Class A.					
" B.					
" C.					
" D.					
" E.					
" F.					
" G.					
" H.					
" I.					
Brass					
Special					
Contract					
Amount					
Cost					

SHAW-WALKER MUSKEGON 7214

FORM 6. RECORD OF DAILY PRODUCT. ORIGINAL 4 x 6 INCHES.

made, supplies issued, or orders taken, without written authority from the office, it does not take long to have everything working right.

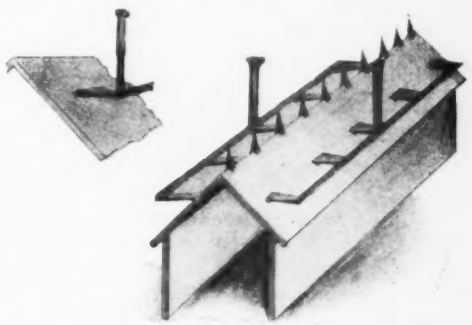
R. W. MACDOWELL.

The Gating of Castings.*

BY BENJAMIN D. FULLER.

This subject, while an interesting one, is rather difficult to talk upon in an entertaining way, as the gating of each individual job represents features peculiar to itself. There is no part of molding in which a mechanic can so readily show his ability, as in the gating of castings. Almost the first thing to be decided when a new job arrives, is the proper method by which the mold may be filled with metal. Many castings are lost just because the molder does not give this question sufficient attention.

There is a large slice of wisdom in the advice given to an apprentice by a son of the Emerald Isle, who was acting as foreman, when he said: "Me bye, if yez waant to make good castin's, yez must ram gintly, vint touroughly, and duve-tail yur gates." And because of not following this advise, especially as to dove-tailing gates, many a casting goes to the scrap pile. Take the casting shown in Fig. 1, which is used to cap off a stone wall, and a glance will show that it is not feasible to force all the iron through a bottom gate, as the casting is very light. At the first line of parting, or at the bottom



IG. 1. RIGHT AND WRONG METHOD OF GATING CASTING FOR WALL COPING.

of roof slope, it will be noticed that there is a sharp bead of sand, running the full length of the pattern, which makes this part of the casting an undesirable place to gate it, as more than likely when the iron strikes this bead, there will be more or less washing or cutting away of the sand. It will also be noticed that "Pop Gates" cannot be utilized,

*From a paper read before the Pittsburg Foundrymen's Association.

as the peak, or the roof of the casting, so to speak, has a row of wrought iron spikes, cast in in such a manner as to prevent the employment of these gates. This casting was made in a three-part flask, the cope line being about 4 inches below the highest point of the pattern, and this is where the casting was gated.

As the illustration shows, these castings are poured double, a runner being cut the full length on both sides, about 6 inches away from the pattern and sprues were cut from these runners to the casting, with a distance of about 3 inches between each. The point I want to illustrate in connection with the gating of this casting is this: The molder cut the sprues deeper where they connected with the runner than where they joined the casting as shown in the illustration, thereby causing the metal to choke at this point, where the mold was least able to resist the pressure, for owing to the peculiar shape of the pattern there was very little support underneath the gate. The result being, that when pressure was exerted against this weak point, the sand broke down and caused the loss of the casting. This trouble was entirely obviated by reversing the shape of the sprues, cutting them smaller at the back and gradually widening and deepening them towards the casting with a slight dove-tail at the junction of the casting, as shown in the smaller illustration to the left. This method confined the pressure of the metal to the runner and allowed a free and yet gentle flow of iron to enter the mold and no further trouble was experienced from the gates breaking in.

As another example of the right and wrong way of gating let us take the casting shown in Fig. 2, which represents a plate about 14 or 16 inches square having a thickness of 3-32 of an inch, and a three inch hole in its center. It is evident that if we cut a runner along two opposite sides, with sprues leading from these to the casting, about 2 inches wide, and a space of 1 inch between each, as would ordinarily be done in pouring such a casting double, that in order to run this, the runners would have to be heavier than the casting, and that after pouring this, they would contain hotter and more fluid iron. In cooling, the casting would set first and later be drawn out of shape by the contraction of the runners. If instead of using the form of gating shown

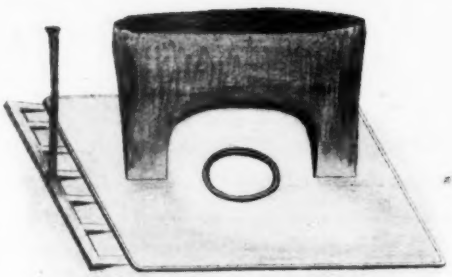


FIG. 2. PROPER AND IMPROPER METHOD OF GATING A PLATE CASTING.

at the left of the casting, we employ what is known as a bridge gate, that is an ordinary flat gate with a semi-circular piece cut out of it, as shown, we will obtain better results. As soon as the casting and gate is set we may give the latter a slight tap sidewise, which will break it off, and leave the casting without any gate attached to it whatever to prevent free contraction. When the mold is finally ready to be shook out the casting should be stood up on edge, when we will have a straight casting, provided the mold has been properly rammed so that the casting is of even thickness. Another advantage accruing from this method of gating is that we can pour the mold with a single ladle.

Take the casting shown in Fig. 3, which is known as the end bracket for a brushless motor, being circular in form, and having a diameter of about 6 feet, with a heavy hub in the center, in which are the bearings for the armature shaft; around the outer rim are bosses through which this casting is bolted to the field casting, while the part between the rim and hub is principally composed of a light checker work or grating, so made for the purpose of ventilation. If we gate this casting upon the rim the iron must flow down towards the center, and while the heavy hub is filling, the metal is slowly moving upwards among the grating. The

FIG. 3. ADVANTAGES OF THE "HORN GATE" FOR CERTAIN DESIGNS OF CASTINGS.

slow filling of the mold generally resulting in seams or cold-shuts being formed. If instead we use horn gates as shown, reaching from outside the circumference of the pattern underneath to the hub, thus filling the heavy center first, the balance of the mold will be filled rapidly and seams in the casting avoided.

What has been said in the foregoing nearly all relates to what may be termed light castings, but errors in gating are ofttimes made, whereby heavy and expensive castings are also lost, as was the case with the one shown in Fig. 4, which is a large spider or armature core weighing in the neighborhood of sixteen tons. The hub is very heavy and connected to the rim by webb shaped arms, the inner circumference being joined to a wide flange top and bottom, the outside having a row of teeth connected with these flanges; the center of the rim

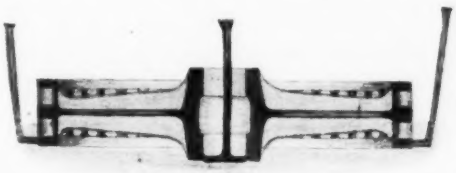


FIG. 4. BENEFITS OF SUFFICIENT GATES FOR LARGE MOLDS.

resembling a shrouded gear wheel except that there is a space between the teeth and inner circumference of the rim to permit ventilation. Originally this casting was poured through the center core to the bottom of the hub as shown, and thus the lower part of the hub was first filled, then the bottom web of the arm received the iron, which traveled along until it reached the inner circumference, when it dropped to the bottom flange. Next the teeth filled slowly to the center of the casting, and by this time the iron in the teeth had become sluggish, due to the distance it had traveled and the time taken to reach this point. At this period the iron stopped moving in the lower part of the rim and the teeth and the upper half of the mold was filled by the flow directly from the arms through the center webb. When the casting was cleaned it was found that a seam ran horizontally through the center of each tooth, just at the point where the iron in the lower half of the

FIG. 5. METHOD OF GATING DEEP MOLDS.

teeth had been met by the flow of metal through the center webb. This defect was remedied by placing gates at the bottom of the rim as shown, as well as through the center core, thus allowing all parts of the mold to be filled equally.

For another design let us take the large dynamo bottom field, illustrated in Fig. 5. This is molded with the light frame or bed part of the casting upwards, while the heavy yoke or field, extends down deep into the floor, with legs at either end of the frame, to which are attached the bearings for the armature shaft, this part of the casting also reaching a considerable distance into the floor. It is not practical to fill this mold from the top as this would allow a great body of metal to rush downward hither and thither through the mold, instead the best way is to place two gates outside of the mold at opposite corners and connecting these with draw-in or covered gates reaching the extremities of yoke and bearings, as shown. As the mold is being rammed up, place a draw gate, so that it extends upward

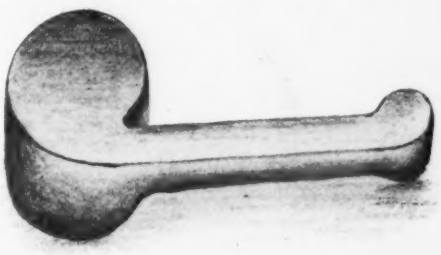


FIG. 6. COMMON FORM OF SKIMMING GATE.

to a point on the frame, which will help to run the lighter or top part of the casting after the bottom gates have ceased to take iron freely, owing to the pressure of the body of metal in the mold. Making this upper draw gate slant upwards will prevent it from taking iron too soon, or until iron in the mold has reached the proper level.

Many are the various forms of gates used in the foundry, each being employed for a

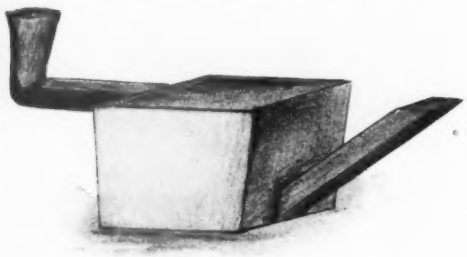


FIG. 7. "TEA POT" SKIMMING GATE.

specific purpose. As far as skimming gates are concerned, the old fashioned style shown in Fig. 6 when properly made is very reliable. In using this the sprue should be cut at such an angle that the iron in its whirling motion will pass the sprue, carrying the dirt and dross with it and lifting this up into the head, placed to receive it. This represents the principle used in casting rolls, where the gate is so placed as to cause the iron to form a whirlpool in the mold, thereby carrying the dross to the center and allowing this to rise into the sinking head at the top part of the casting.

Another excellent form of skimming gate is the tea-pot gate shown in Fig. 7 where the metal must find its way down through the basin of the gate and thence upward

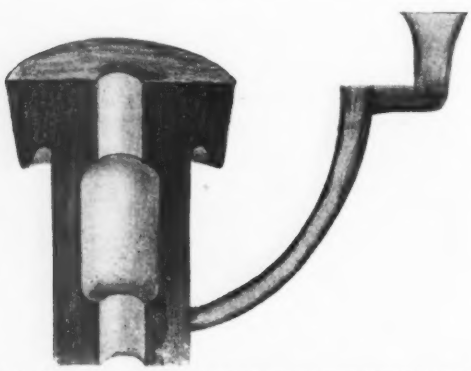


FIG. 8. ANOTHER METHOD OF USING THE HORN GATE.

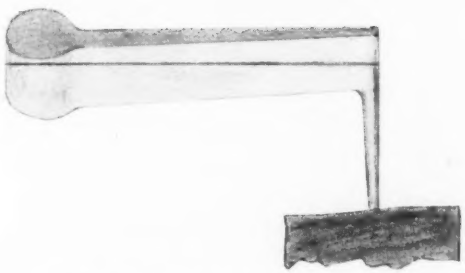
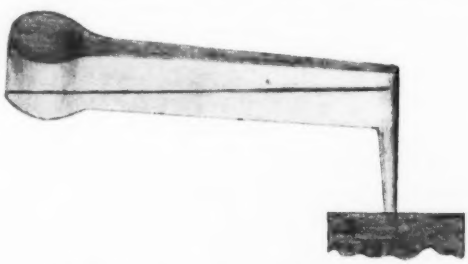


FIG. 9. WRONG WAY TO BUILD A RUNNER.

through the spout to the sprue, thus permitting the dirt to remain in the top of the reservoir. The horn gate may be employed in manifold ways, one of which is shown in Fig. 8. Here we have an armature bushing which cannot very well be gated from the top of the mold owing to the sharp bead of sand, over which the iron would flow, thus causing it to cut or wash away. By filling the mold with the aid of the horn gate all these difficulties are overcome.

Many are the features relating to the pouring of molds which could be taken up in this connection, but I will conclude by calling attention to one defect very often met with in the making up of runners, made either in runner-boxes or cut into the mold itself. We frequently see a runner cut deep



THE RIGHT WAY TO MAKE A RUNNER.

at the bowl or pouring end, and rising from this point until the gate is reached as shown in Fig. 9. This method is a mistake, as when the iron leaves the ladle and the bowl of the runner fills, the dirt will gather on top of the runner and gradually approaching the gate will roll nicely over the point into the gate and from there into the casting.

This method leaves the part of the runner next to the gate too high and without a sufficient body of metal to float the dirt. By giving the bottom of the runner a downward slant from the bowl to the gate, as shown in

Fig. 10, when the iron floats along the dirt will be quickly shot down the runner where it will strike the end and rise, and provided the gate is not disproportionately large, it can easily be kept floating on the top of the runner until the mold is full. The lines drawn through the runners in Figs. 9 and 10 show the relative level of metal which will prevail in the different parts of the runners during pouring. Gates and sprues protruding from castings do not help to increase their beauty, and I once had a gentleman, occupying a high official position, ask me if I could not make castings without gates. Once in a while I have seen molds poured, when the results were gates without castings through the molder having forgotten to cut the sprues, but I have not seen castings made without gates, except in the form of open sand molds.

Steel Foundries in the United States and Canada.

The manufacture of steel castings has increased at a very rapid rate within recent years and the limits, within which it is economical to use this class of castings, have constantly widened. Methods of molding have been improved and the metallurgical side of this branch of the foundry trade has received its full share of attention with the result that quality has been improved and the cost of making steel castings reduced. We append a list of the plants engaged in turning out steel castings at the present time and the process employed, together with their annual capacity. In some instances, owing to the absence of direct information upon the latter point, we have been compelled to estimate the capacity of several plants, and where such is the case, the figures relating thereto appear with an asterisk (*).

ALABAMA.

Tennessee Coal, Iron & Railroad Co., Ensley, Ala. Basic open-hearth. 10,000 tons*.

CALIFORNIA.

Union Iron Works, San Francisco, Cal. Tropenas. 300 tons. Output consumed by company.

COLORADO.

Colorado Fuel & Iron Co., Pueblo, Colo. Bessemer. Makes castings for own use only.

CONNECTICUT.

Malleable Iron Fittings Co., Branford, Conn. Acid open-hearth. 4,000 tons.

ILLINOIS.

American Steel Foundries (Sargent plant), Chicago, Ill. Crucible. 600 tons. Acid open-hearth. 7,500 tons*.

American Brake Shoe & Foundry Co., Chicago Heights, Ill. Tropenas. 3,000 tons.

American Steel Foundries (Leighton & Howard plant), East St. Louis, Ill. Basic open-hearth. 20,000 tons*.

American Steel Foundries (Granite City plant), Granite City, Ill. Basic open-hearth. 20,000 tons*.

Commonwealth Steel Co., Granite City, Ill. Basic open-hearth. 75,000 tons.

Illinois Steel Co., Joliet, Ill. Bessemer. Makes no castings for the general market.

Latrobe Steel & Coupler Co., Melrose Park, Ill. Acid open-hearth. 30,000 tons.

INDIANA.

Gould Steel Co., Anderson, Ind. Acid open-hearth. 5,000 tons.

National Car Coupler Co., Converse, Ind. Acid open-hearth. 8,000 tons.

Matthews Steel Casting Co., Matthews, Ind. Acid open-hearth. 8,000 tons.

National Steel Casting Co., Montpelier, Ind. Acid open-hearth. 3,500 tons.

Whiteley Steel Co., Muncie, Ind. Special process. 1,500 tons.

Peru Steel Casting Co., Peru, Ind. Basic open-hearth. 18,000 tons.

MASSACHUSETTS.

Tool Steel Casting Co., Chelsea, Mass. (Office Boston.) Crucible. 500 tons.*

United States Steel Co., West Everett, Mass. Crucible and acid open-hearth. Crucible. 2,000 tons. Acid open-hearth. 10,000 tons.

General Electric Co., Lynn, Mass. Acid open-hearth. 10,000 tons.

MICHIGAN.

Detroit Steel Casting Co., Detroit, Mich. Robert-Bessemer. 5,000 tons*.

MINNESOTA.

American Hoist & Derrick Co., St. Paul, Minn. Tropenas. All castings consumed by company.

MISSOURI.

Scullin-Gallagher Iron & Steel Co., St. Louis, Mo. Acid and basic open-hearth. 20,000 tons*.

NEW JERSEY.

Uniform Steel Co., Rahway, N. J. Crucible. 3,000 tons.

Graphite Metal Co., Garwood, N. J. Special process. 800 tons.

Taylor Iron & Steel Co., High Bridge, N. J. Hadfield special process. 10,000 tons.

Benjamin Atha & Co., Newark, N. J. Acid and basic open-hearth. 15,000 tons.

NEW YORK.

Chrome Steel Works, Brooklyn, N. Y. Crucible. 3,000 tons.

Pratt & Letchworth Co., Buffalo, N. Y. Acid open-hearth. 7,500 tons.

John Drew Steel Foundry, Lockport, N. Y. Special Crucible. 1,000 tons.*

Isaac G. Johnson Co., Spuyten Duyvil, N. Y. Crucible and acid open-hearth. 7,500 tons.

OHIO.

American Steel Foundries (Alliance Works), Alliance, O. Acid open-hearth. 20,000 tons.*

Canton Saw Co., Canton, O. Crucible. Small output, largely for company's use.

Cleveland Steel Casting Co., Cleveland, O. Acid, open-hearth. 30,000 tons.

Otis Steel Co., Cleveland, O. Acid and basic open-hearth. 10,000 tons.

Wellman-Seaver-Morgan Engineering Co., Cleveland, O. Basic open-hearth. 6,000 tons.

Buckeye Malleable Iron & Coupler Co., Columbus, O. Acid and basic open-hearth. 45,000 tons.

Marion Steam Shovel Co., Marion, Ohio. Robert-Bessemer. 3,000. Greater part of output consumed in company's works.

Coxey Steel & Silica Sand Co., Mt. Vernon, Ohio. Acid open-hearth. 18,000 tons.

Newark Iron & Steel Co., Newark, O. Acid open-hearth. 3,000 tons.

United Engineering & Foundry Co. (Lloyd Booth Co. Dept.), Youngstown, O. Acid open-hearth. 6,000 tons.

Youngstown Steel Casting Co., Youngstown, O. Acid open-hearth. 3,000 tons.

PENNSYLVANIA.

Diamond Drill & Machine Co., Birdsboro, Pa. Acid open-hearth. 5,000 tons. Expect to double capacity during 1903.

Sterling Steel Foundry Co., Braddock, Pa. Acid open-hearth. 30,000 tons.

Standard Steel Works, Burnham, Pa. Acid open-hearth. 6,000 tons. Output principally consumed by company's works.

American Steel Foundries (Chester plant), Chester, Pa. Acid open-hearth. 25,000 tons.*

Chester Steel Casting Co., Chester, Pa. Acid open-hearth. 10,000 tons.*

Penn Steel Casting & Machine Co., Chester, Pa. Acid open-hearth. 12,000 tons.*

Seaboard Steel Casting Co., Chester, Pa. Acid open-hearth. 20,000 tons.

Solid Steel Casting Co., Chester, Pa. Acid open-hearth. 9,000 tons.

Lukens Iron & Steel Co., Coatesville, Pa. Acid open-hearth. Makes castings for own use only.

Duquesne Steel Foundry Co., Coraopolis, Pa. (Office, Pittsburg). Acid open-hearth. 12,000 tons.

American Steel Foundries (Franklin Works). Franklin, Pa. Acid open-hearth. 10,000 tons.*

Pittsburg Steel Foundry, Glassport, Pa. (Office, Pittsburg). Acid and basic open-hearth. 25,000 tons.

Carnegie Steel Co., Homestead, Pa. Open-hearth. Makes castings for its own use only.

Mesta Machine Co., Homestead, Pa. (Office, Pittsburg). Acid open-hearth. 10,000 tons.

Lorain Steel Co., Johnstown, Pa. Acid open-hearth. 7,000 tons.

Carbon Steel Casting Co., Lancaster, Pa. Special process. 1,000 tons.

Midvale Steel Co., Philadelphia. Basic open-hearth. 3,000 tons.*

Philadelphia Steel & Iron Co., (Frankford) Philadelphia, Pa. Special Process. 500 tons. Expect to build Bessemer plant in near future.

Stanley G. Flagg & Co., Philadelphia, Pa. Special process. 500 tons.

Wm. Wharton, Jr., & Co., Philadelphia, Pa. Tropenas. 2,000 tons. Output consumed by company.

Phoenix Iron Works, Phoenixville, Pa. Acid open-hearth. 2,500 tons.* Output consumed by company.

Jones & Laughlin Steel Co., Pittsburg. Acid open-hearth. Makes castings for own use only.

McConway & Torley Co., Pittsburg, Pa. Acid open-hearth. 15,000 tons.

Mackintosh, Hemphill & Co. (Fort Pitt Foundry), Pittsburg, Pa. Acid open-hearth. 2,500 tons.

American Steel Foundries (Reliance plant), Pittsburg, Pa. Crucible and acid open-hearth. 3,000 tons.*

Union Steel Casting Co., Pittsburg, Pa. Acid open-hearth. 7,000 tons.

Brylgon Steel Casting Co., Reading, Pa. Bessemer. 2,500 tons.

American Steel Foundries (Sharon plant), Sharon, Pa. Acid open-hearth. 25,000 tons.*

National Malleable Castings Co., Sharon, Pa. Acid open-hearth. 18,000 tons.*

Bethlehem Steel Co., Bethlehem, Pa. Crucible and acid open-hearth. 15,000 tons.*

Pennsylvania Steel Co., Steelton, Pa. Acid open-hearth. 15,000 tons.

Norway Iron & Steel Co., York, Pa. Acid open-hearth. 3,000 tons.

TENNESSEE.

John Leighton & Sons, Chattanooga, Tenn. Small output of Crucible steel castings.

WISCONSIN.

Clinton Burnham Foundry Co., Milwaukee, Wis. Crucible. 300 tons.

Crucible Steel Casting Co., Milwaukee, Wis. Crucible. 650 tons.

J. A. & P. E. Dutcher Co., Milwaukee, Wis. Crucible and acid open-hearth. 1,000 tons.*

Falk Co., Milwaukee, Wis. Acid open-hearth. 12,000 tons.

Bay View Steel Casting Co., Milwaukee, Wis. Crucible and acid open-hearth. 900 tons.*

Geo. H. Smith Steel Casting Co., Milwaukee, Wis. Bessemer. 3,000 tons.

Nortmann & Duffke Foundry Co., Milwaukee, Wis. Crucible. 1,000 tons.

Shaw-Gerlinger Steel Casting Co., West Allis, (Milwaukee) Wis. Crucible. 450 tons.

CANADA.

Wm. Kennedy & Sons, Owen Sound, Ont. Tropenas. 500 tons.

Canada Switch & Spring Co., Montreal, P. Q. Acid open-hearth. 5,000 tons.

Arranging the above information according to states, and omitting the capacity of eight plants making castings for their own use only, we have the following figures:

State.	No. of Steel Foundries.	Annual Capacity.
Alabama	1	10,000
California	1	300
Colorado	1	.....
Connecticut	1	4,000
Illinois	7	156,100
Indiana	6	44,000
Massachusetts	3	22,500
Michigan	1	5,000
Minnesota	1	.....
Missouri	1	20,000
New Jersey	4	28,500
New York	4	19,000
Ohio	11	144,000
Pennsylvania	32	296,300
Tennessee	1	.....
Wisconsin	8	19,300
Canada	2	5,500

The total number of plants making steel castings is 85, of which 77 claim a capacity of 774,700 tons per annum. The word capacity as here used is very elastic in its application and has only a remote connection with the actual output of the plants. In nearly every instance the figures quoted represent the melting capacity, just as a gray iron foundry may be able to melt 200 tons of iron at a time and yet not have an output exceeding 40 tons of castings per day. It is evident that it would be difficult for many of these plants to reach their "full capacity" if this had to be poured into the average run of steel castings. With the capacity claimed there would seem to be but little need of the erection of additional works, and yet buyers of steel castings are complaining of delayed deliveries, which would indicate that a lack of molding space rather than melting capacity is responsible for this condition. A few of the steel foundries also make special ingots, which of course should not be included under the head of castings, although made in sand molds; at the same time, as is well known, it is difficult for a foundry to divide its tonnage.

In this connection it is interesting to note the report made to the Census Bureau of 1900 by Wm. G. Gray, special expert. Mr. Gray found the output of steel castings that year to have been 177,156 gross tons, of which open-hearth led with 165,529; Bessemer 3,761, and crucible and special processes 7,866. There were 44 establishments making open-hearth castings in 1900, while our figures show 57 at the beginning of 1903, a net gain of 13. Mr. Gray gives the average value per ton of steel castings in 1900 as being $81.43 in Pennsylvania, $67.95 in Illinois and $77.93 in Ohio. The value of crucible steel castings per ton in the same year is given as $150.85 for Wisconsin, $148.30 for Pennsylvania and $135.13 for Illinois. The total value of all steel castings produced in 1900 is $14,609,893.

With the extensive additions that have been made to older plants and the rapid increase in the number of new works which has taken place in recent years, the annual output of steel castings should at a conservative estimate soon reach 350,000 tons. It may be mentioned that of the 57 foundries making open-hearth steel castings at the present time, eight, with an estimated capacity of 130,500 tons, are owned by one company. Accepting these figures as nearly correct the leading concern in this industry controls about 18 per cent of the trade.

The open-hearth process is employed by 57 foundries, the Bessemer process, or modifica-

tions of same, by 11 foundries; special processes are used by 7 makers of steel castings and the crucible process exclusively by 10 foundries. In addition to making steel castings by the open-hearth or the Bessemer process a number of foundries also make crucible castings. Concerns of this class are not included in the figures quoted for this branch of the trade.

In addition to the active concerns listed above the following companies have been organized to make steel castings:

Colorado Steel Casting Co., Colorado Springs, Colo.

Lima Locomotive & Machine Co., Lima, Ohio, contemplate the manufacture of steel castings in their new foundry, which it is expected will be completed within a year.

Norwalk Steel & Iron Co., Norwalk, Ohio, are reported as intending to erect a steel casting plant during 1903.

The Filer & Stowell Co., of Milwaukee, Wis., will include a steel casting department in their new foundry, now under construction. This is to have a 15-ton open-hearth furnace.

Ottawa Steel Casting Co., Ltd., Ottawa, Ontario. Company recently organized and likely to build plant during present year.

The Henry Steel Casting Co., St. Louis, Mo., have recently been incorporated. No details as to the plans of this company are at hand.

The Blytheville Foundry & Machine Co., of Blytheville, Arkansas, has been incorporated with a capital stock of $10,000. H C. Daniels is president, Elisha L. Sawyer, vice president, and J. S. Johnson, secretary and treasurer.

Wale & Eccleston of Nebraska City, Neb., have sold their plant, known as the Nebraska City Iron Works, to Mueller & Nichelson.

W. E. Allen and J. H. Harwood have started a new foundry at Bloomington, Ill.

The Madison Avenue Foundry Co., of Cleveland, Ohio, has increased its capital stock to $35,000.

F. R. Sargent intends to establish a foundry at Imlay City, Mich., during the early part of the year.

The Woonsocket Machine & Press Co., Woonsocket, R. I., is extending its foundry.

The Culver Foundry at West Oneonta, N. Y., has been purchased by H. B. Taber.

The Advantages of Trolley Tracks in Foundries.

At a recent meeting of the Philadelphia Foundrymen's Association, A. W. Moyer of J. W. Moyer & Co., Philadelphia, read a paper dealing with the installation of trolley tracks as a means of reducing the cost of handling material in manufacturing establishments. Generally the employment of several laborers is necessary to move things

LADLE UNDER CUPOLA SPOUT.

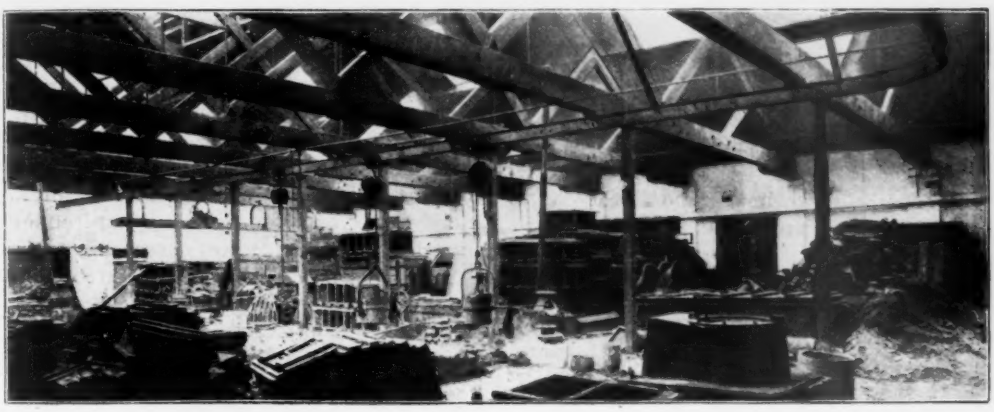
Showing method of locking the former in position while being filled.

from one place to another by ordinary methods, when with the assistance of a trolley track the same could be accomplished by one man or even a boy. The cost of installing such a system is insignificant in comparison with the labor-saving effected by its use. Plenty of instances are on record where the entire cost of a tramrail system, quite extensive in character, has been saved in one year in labor economies alone; while the saving in time, the increase in manufacturing facilities, the simplification of the shop system, and the increased floor space, would place the shop far on the debtor's side of the installation account.

The author referred to a trolley track system installed in the foundry of a New York concern manufacturing bath tubs, hoppers, plumbers' supplies and stable fittings. Some difficulties were encountered owing to the irregular construction of the building. An I beam system is used which

is considered better for carrying heavy loads or molten metal. The trolleys have wheels on both sides of the track, so that it is impossible for them to lose their base. The foundry comprises practically four large molding shops, one cupola supplying all four. The shops are quite large and before the tramrail was put in, considerable trouble was experienced due to the cooling of the iron. A 30-ton cupola supplies all floors, and the average heat is about 23 tons per day. The cupola is located between two of the shops and is not in the most convenient location for pouring, and were it not for the introduction of a tramrail system, it would be necessary to have extra cupolas to supply the demand made by an ever-increasing business. The situation of the cupola is such due to the tramrail system. Liberal use is made of the system in this building for conveying the heavier castings. In another view is shown the switching arrangement, where two lines of tramrail cross each other at right angles, and where ordinarily a turntable is used. In the Moyer system, turntables are never used on account of their high cost, the great amount of head room required, and the liability of getting out of order. Instead two- and three-way switches are used, with the result that a load is more quickly handled, and the possibility of a load being pushed from the rail is entirely done away with.

Mr. Moyer referred to a system of trolley tracks in operation at a foundry in Bridgeport, Conn., making pipe fittings. This shop

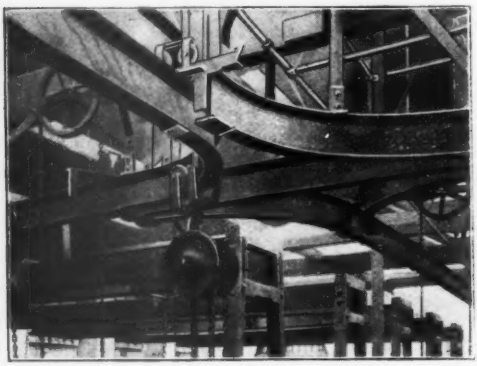


SYSTEM OF TROLLEY TRACKS IN A NEW YORK FOUNDRY. LADLES CARRIED BY TRIPLEX HOISTS.

that in carrying small quantities of molten metal the distance necessary to reach the molds there would ordinarily be trouble from cold metal. The system of pouring in this case is simply to fill large ladles with one or two tons of metal, run them to a point in the foundry where they can be gotten at with as little trouble as possible and then pour to smaller or hand ladles, repeating this operation as many times as necessary.

One of the illustrations shows the trolley track entering this foundry, turning and running the whole length of the building, serving the floors on each side. The ladles are carried by triplex hoists and handled by two men. Owing to the extreme width of the building and the consequent danger of overstraining the roof girders, posts have been placed at intervals to carry any strain is 330 feet long by 150 feet wide and has two cupolas, separated at equal distances from each other and from the ends of the foundry. By a test it was seen that two men were able, without undue exertion, to carry a full ladle, or "growler," filled with 1,500 pounds of molten metal from either of the cupolas to either end of the foundry in one minute. It would take two men double or triple that time to carry a ladle holding but 150 to 200 pounds of metal. In other words, two men were carrying in one minute a load which if divided up into 150-pound ladle loads, would have taken 20 men twice the time to carry by hand. Laborers in the foundry are paid $1.50 per day and it is this class of laborers who run the ladles along the track. Only twelve laborers are employed at a daily wage of $18, or $5,400 per year. If only three times the amount of

labor were required if the tramrail system were not used, the wage would be $16,200; and by subtracting $5,400 from that sum, we find that if the 12 laborers worked all day at carrying the ladles, there would have been a saving of $10,800. But as by means of these 12 men and two cupolas, 52 tons

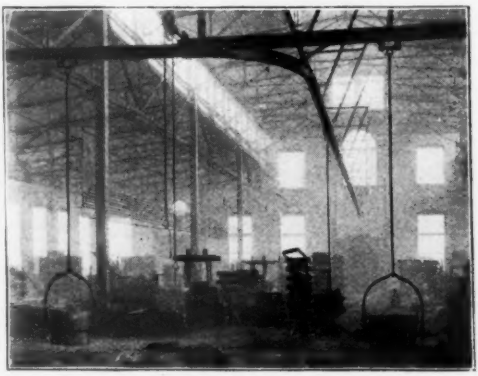


SWITCHING ARRANGEMENT FOR I BEAM TROLLEY TRACK.

are poured in two hours, and as the day is an 8-hour day, the actual yearly saving in this item alone is $2,100. The system cost the firm $3,000 and the president informed the writer that they had actually saved the first cost in half a year's run. Besides being used for carrying iron the trolley track is employed for many other purposes in which labor as well as time is saved.

The foundry floor is nearly clear, only having a double row of posts. A double skylight runs the length of the building, operated by one wheel and chain from one end. It was found, however, that better ventilation could be obtained by cutting this operating device up into four, consequently each row, 330 feet long, was divided into four sections. The two cupolas each melt in two hours and forty minutes, thirty-seven tons of metal, or 74 tons for the two. Hydraulic elevators, working on the outside of the building, raise the pig iron, coke and scrap 20 feet to a platform. Instead of the large doors at either end of the foundry sliding sidewise, thereby cutting off light, they raise and lower, as easily as an ordinary window sash. On each side of the foundry, from wall to wall, the tramrail, extends. Across the center in front of both cupolas are branch lines and again another line runs the long way down the center, switching in turn into the cupola tracks. This leaves a square space in front of and between the cupolas clear of tramrail, and in this space stationary cranes operate. From the floor to the roof is 36 feet and the "Y" hangers are 20 feet long, making the track 16 feet from the ground. These "Y" hangers are made of bar iron, twisted and well braced. At the I beam, they fasten with a clamp on top and are clamped to the roof truss as well. There is little or no side sway or vibration while the load passes along the system.

At the cupola the ladle suspended from the tramway receives the molten metal. Simple hinged pieces, fastened to the brickwork, hold the ladle firmly in place while being filled, preventing the possibility of spilling, and these are easily folded back against the wall when not in use. One "growler" never waits on another under this arrangement, for after a few weeks' use the workmen get to understand that the easiest way to operate the system is the right way, and in the words of the old foreman of the foundry, "the boys never made so much money and worked so little, lugging iron, in their lives." Arrangements are being made to connect the six ends of the three runs in this foundry, and when this is done the system will consist virtually of two con-



SYSTEM OF TROLLEY TRACKS IN A CONNECTICUT FOUNDRY.

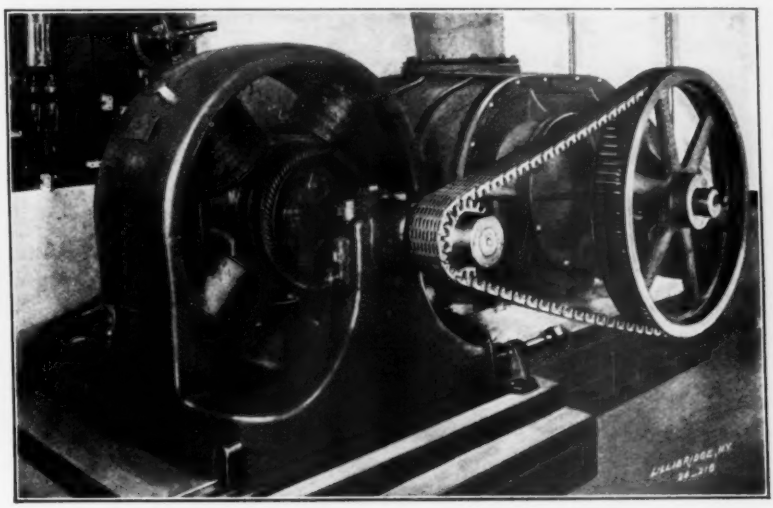
tinuous loops with branches, each loop designed to convey the metal from one cupola only, although being so connected as to be able to reach any part of the foundry floor from either or both cupolas. When this is done, in my opinion, this foundry will be one of the best equipped foundries it has been

my privilege to see—best equipped, let me say, along the lines of conveying molten metal to the molders, and taking the castings away from the molders when finished.

I firmly believe that no matter how poor the system, no matter whose make, a tramrail system of almost any kind will be of vast benefit in nearly every foundry. As to the relative merits of different styles of tramrail systems I will say, however, that those of the iron foundries who have used systems of different kinds are a unit in the opinion that an I-beam system, no matter whose make, is by far the best all-round system made to-day. It should be remembered that no two systems are alike, and that each must be adapted to the special requirements of that particular foundry in which it is to be used. One may save in one direction and one may save in another, but with the proper use of the proper system I feel sure that the trolley track in one year will return to its purchaser dollar for dollar of its original cost, with a few extra dollars thrown in for good measure.

The Renold Silent Chain Gear.

We show with this an illustration of a blower installation in which the blower is connected to the motor by the means of the Renold Silent Chain, manufactured by the Link-Belt Engineering Co. of Philadelphia, who say that instead of the usual expensive low speed special motor required for direct connection, a standard motor and Silent Chain may be used, forming an outfit, which, while sacrificing none of the advantages of positive connection and compactness of the direct-connected type, yet allows the use of a cheaper motor. As compared with a belt, the Renold Silent Chain may be run on shorter centers and used in hot, damp places.



35 H. P. SILENT CHAIN DRIVE FROM VARIABLE SPEED GENERAL ELECTRIC MOTOR TO POSITIVE PRESSURE FOUNDRY BLOWER.

Pig Iron Prices for Sixty Years.

The *Bulletin* publishes a table which shows the following average yearly prices of No. 1 Foundry pig iron at Philadelphia for the last sixty years:

1843, $25.60; 1844, $25.75; 1845, $29.25; 1846, $27.88; 1847, $30.25; 1848, $26.50; 1849, $22.75; 1850, $20.88; 1851, $21.38; 1852, $22.63; 1853, $36.12; 1854, $36.88; 1855, $27.75; 1856, $27.12; 1857, $26.38; 1858, $22.25; 1859, $23.38; 1860, $22.75; 1861, $20.25; 1862, $23.88; 1863, $35.25; 1864, $59.25; 1865, $46.12; 1866, $46.88; 1867, $44.12; 1868, $39.25; 1869, $40.63; 1870, $33.25; 1871, $35.12; 1872, $48.88; 1873, $42.75; 1874, $30.25; 1875, $25.50; 1876, $22.25; 1877, $18.88; 1878, $17.63; 1879; $21.50; 1880, $28.50; 1881, $25.12; 1882, $25.75; 1883, $22.38; 1884, $19.88; 1885, $18.00; 1886 $18.71; 1887, $20.92; 1888, $18.88; 1889 $17.75; 1890, $18.40; 1891, $17.52; 1892, $15.75; 1893, $14.52; 1894, $12.66; 1895, $13.10; 1896, $12.95; 1897, $12.10; 1898, $11.66; 1899, $19.36; 1900, $19.98; 1901, $15.87; 1902, $22.19.

Britannia Metal Ornaments.

Where only a few castings are wanted, it is stated that plaster of Paris molds treated to a coat of silicate of soda (water glass) and thoroughly dried answer very well for ornaments made from Britannia metal. When this class of castings are called for in large quantities, the use of brass molds is recommended.

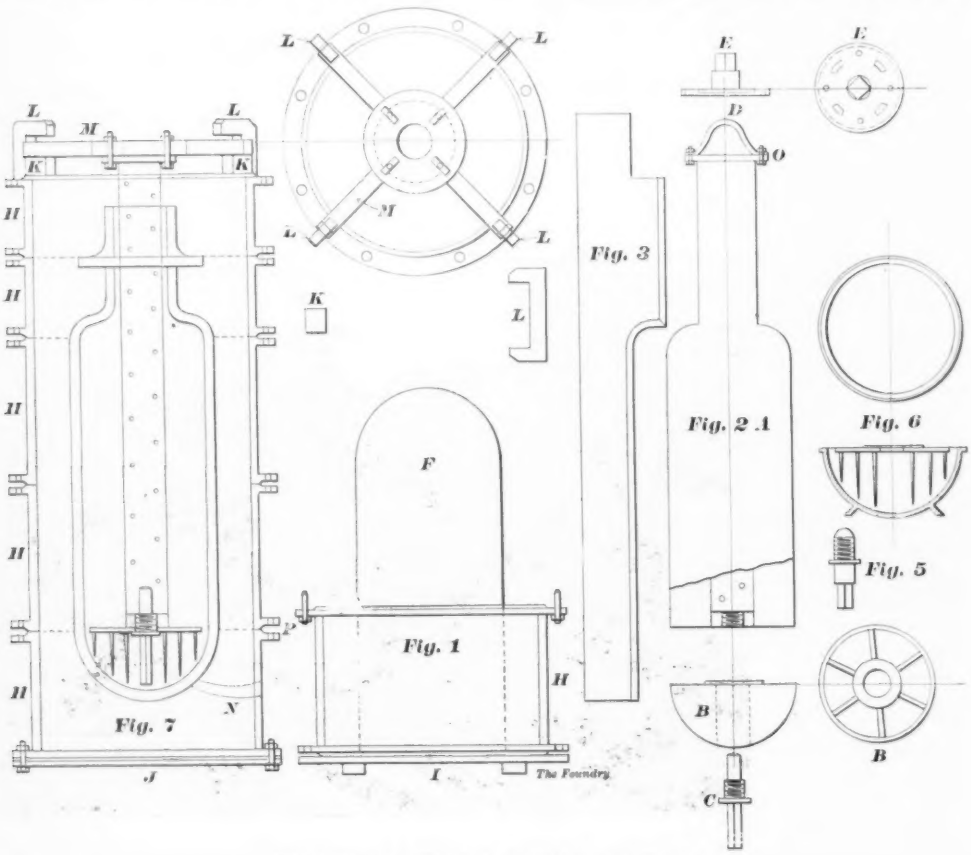
Molding Air Chambers without Using Chaplets.

Among the castings which are difficult to mold without the use of anchors or chaplets are the air chambers used on pumps. When one looks at some of these castings it actually appears as if they were a parody on Tennyson's "Charge of the Light Brigade." They have anchors to the right of them and anchors to the left of them, etc., not to mention the unsightly buttons which the molder has made in the mold with his trowel handle, without any regard to the semblance of symmetry.

At the foundry of the Scranton Steam Pump Co., Scranton, Pa., they follow a method of molding these castings which will be described in this article. By making an air chamber casting after this plan anchors and chaplets are eliminated and some slight saving effected in trowel handles, and aside from these considerations is the assurance that the chances of losing the casting will be reduced to a minimum, due to the fact that the mold can be examined after it is all put together with the core in position, previous to the final closing of the mold, something which cannot be conveniently accomplished when the flask is in two halves and the core anchored from four sides.

Fig. 7 shows a plan and section of an air chamber casting, the flask in which it is molded, and the arbor which is used to secure the core. The pattern should be divided as shown by dotted lines, although it need not, however, necessarily be divided where the pattern curves towards the apex of the chamber, thereby effecting a saving of time in the pattern shop, as the molder can conveniently form the joint of the mold at that point previous to placing the bottom part of the flask in position.

Fig. 1 shows the pattern F and the flask H, in position on the follow board I, preliminary to ramming up the mold. When this is accomplished the joint is made, as



MOLDING AIR CHAMBERS WITHOUT CHAPLETS.

mentioned above, the mold is turned over by trunnions, not shown in sketch. Another advantage gained by this method of molding is that the air chamber may be made of any length by simply drawing up the pattern and adding additional sections of flasks until the required length is reached, thereby reducing the cost of pattern to the minimum. The flange and neck of the pattern being loose, these can be placed in position after the main part of the pattern has been rammed up. The remainder of the mold can now be finished, not omitting the pin by which the core is centered.

The core, Fig. 2, is made in loam in the usual way by the aid of the sweep, Fig. 3. Several wooden plugs should be firmly driven into the core barrel at that part which covers the largest diameter of the core. This should be done previous to putting on the hay rope, as these will materially assist in holding the rope in position when the upward pressure of the iron strikes the core.

In sweeping up the main part of the core the flange with trunnion attachment E, Fig. 2, and the trunnion, Fig. 5, are used. When the core is ready for the mold the trunnions are removed and the bail D, Fig. 2, bolted on before up-ending the core. A square block of wood is placed under the trunnion, Fig. 5, and after the core is hoisted up this can be removed and the bottom core B placed in position, the retaining bolt C being inserted through this and tightened by the aid of the threads in the end of the core barrel. This retaining bolt will hold the bottom core firmly in place, and wherever divisions exist between this and the main core these are easily filled in and blackened over, when a small wood fire will dry this in a few minutes and the core is then ready for the mold. Previous to lowering the core four strips of rubber or leather about one inch wide and the thickness of the metal required should be placed in the mold, meeting each other in the bottom and extending up the sides four or five inches with a slight taper; this enables the core to find its center readily.

The bail D and flange O, which is tapped and screws onto the core barrel, is now removed to allow the neck and flange part of the mold to pass over the core; the core is then placed in position and the flange O replaced. Next the cross M is put on and bolted fast to the flange O of the core barrel; the blocks K are then placed under the arms of the cross M, with iron wedges between the cross and the blocks. The latter may be either of cast iron or hardwood.

The upper part of the mold and core can now be hoisted from the bottom joint P, Fig. 7, the leather strips removed, and the mold cleaned of any particles which may have fallen in while the core was being secured. The core should now be centered with a pair of callipers along the sides of the joint line, and may be moved in any direction required by the adjustment of the iron wedges underneath the cross M. It is the practice to gate these castings at the bottom by using the horn gate N.

It is unnecessary to give details about securing around the top of the core, or building the runner, not because these things are of minor importance, but rather because no hard and fast rules can be laid down to suit every molder. Care should be taken to loosen the clamps L as soon as the metal is set in the mold, so as to provide for the expansion of the core barrel, as otherwise the casting is liable to fracture. To remove the core barrel from the casting all that is necessary is to revolve the cross M, when the core barrel will free itself from the retaining bolt C and can then readily be lifted away. The retaining bolt C may be used as often as required. Fig. 6 is a plan and sectional view of the core box for the core B. When there are a number of these castings to be made it is a decided advantage to have light cast iron boxes, which can easily be made in the foundry by the exercise of a little ingenuity and a couple of sweeps.

J. TEMPLE MACCARTNEY.

Avoiding the Use of Three-Part Flasks.

For decades before the foundrymen of today put his shoulder to the wheel of industry, molding in three part flasks was practiced and called forth the best skill of the molder. Nothing is surer than that this class of molding affords great opportunity for the display of skill upon the part of the molder, yet, the fact nevertheless stands indisputable that it is a very expensive method of turning out castings for a foundry and makes a poor job, from the manufacturer's point of view, even of a certain type of castings which can be made

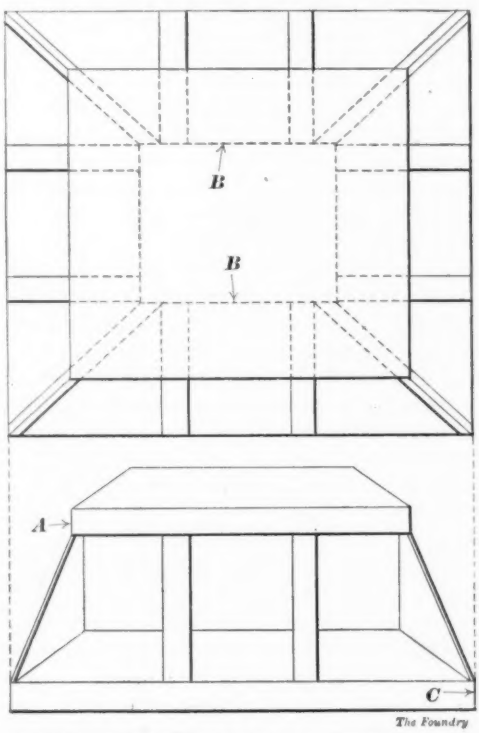
profitable after this fashion. This fact has accordingly fostered very many ingenious plans for doing away with this method of molding whenever possible.

While these plans have been handed down from one generation to the next, and in turn been modified to suit varying conditions, we still find many foundries which do not use these improvements to further their interests as they should. This is due principally to three causes, the first of which and the least common, is a lack of knowledge along this line on the part of our foundry foremen. The second reason is a lack of proper encouragement on the part of the foundry managers who make the foundry foremen hesitate to go to the expense of a few cents for alterating a pattern, even when such an alteration in the end would save dollars in the cost of molding. Whenever a foundry has a pattern shop of its own no short-sighted policy should be followed which encourages the construction of a pattern so it has to be molded in a three-part flask, when the casting is of such a design that a little additional pattern work will give us a pattern that can be molded perhaps in half the time. The last reason and perhaps the chief one why we use as many three-part flasks as we do, is the lack of that keen interest and attention to details that transfers a foundry from a tolerated adjunct to the machine shop and a poor paying investment to a liberal money-making organization.

An example along this line which may not have come under the personal attention of all the readers of this journal is shown in the cast bases, of which a large tonnage is now being turned out by both iron and steel foundries. These bases are used principally in bridge construction and for bases of columns for our modern skyscrapers. The most common sizes weigh about one ton apiece and are about 30 inches square on the larger side and from six to twenty-four inches high. The pattern illustrated shows the general form of these castings.

These patterns are received by the foundry from the bridge companies or contractors with the plate part of the pattern, as shown at A, loose, and as constructed there is but one practical way to mold them and that is in a three-part flask. Our enterprising foundry foreman however, substitutes for plate A a smaller piece of the same thickness as A, but small enough to be drawn out of the mold through the central part of same as indicated by the dotted lines B. This smaller part of the pattern we will in this description refer to as B. If the central part of the base is cored out in order to lighten the casting the proper core print can readily be placed on the smaller plate B. From now on the rest of the job is relatively plain and simple. The drag is rammed up with the plate C resting on the follow board until the upper plate A is reached. By then using the original piece A, we secure our mold around the edge of same, true to pattern. Then A is removed and placed to one side and the piece B is again substituted. At this juncture plain slab covering cores of the proper size are used and the rest of the work is the plainest kind of molding.

Double shrouded gears ranging from three to six feet in diameter and larger can be molded much cheaper than many foundries are doing today by having the drag shrouding split length-wise and the part that projects beyond the root of the teeth cut into segments to be drawn in after the main part of the pattern is withdrawn from the mold. If more than two or three castings are re-



MOLDING A THREE-PART JOB IN A TWO-PART FLASK.

quired from one pattern we are eminently justified in altering the pattern if it has been constructed with the drag shrouding in one piece. The same idea can be carried out in the molding of large ladle bands, with a flange on the top and bottom edges, such as are now being cast extensively in steel.

There are of course many designs of shrouded gears that do not admit of this kind of treatment on account of the fact that the rim is not heavy enough to allow the shrouding pieces to be readily drawn out after the pattern has been removed from the mold. There is, however, a much simpler method of molding gears of this type than that commonly followed. The writer has been in close touch with the practice of the majority of the steel foundries in this country and knows that a few of these have developed this method. In the plan referred to the drag is rammed in the regular way up to the top edge of that part of the pattern which forms the shrouding. This shrouding piece is then drawn from the mold, and circular slab-cores are used to cover the same. One man will mold twice as fast by following this plan, as he will by the common method of making the teeth part of the gear in a separate part of the flask. Two or three different sized inexpensive segment core-boxes form all the expense necessary in order to adopt this method.

The old scheme of using cores to cheapen molding is very profitably cultivated by many, but neglected by others to their monetary loss. Molding in three-part flasks is comparatively more expensive for the steel than for the iron founders, because the iron and steel plate flasks for the former are mostly made in one or two depths, and do not admit of the easy modification that wooden flasks do; therefore, some of the methods here illustrated are of more value to the steel founders than to others. The principle I have here endeavored to illustrate is one that goes to make up some of the many details which combine to make a foundry successful or otherwise.

J. B. HENRY.

The Silver Bros. Iron Works Co. of Salt Lake City, Utah, intend to erect a new plant at an early date.

The Keystone Pattern & Foundry Co. of Evans City, Pa., has been acquired by the Seelar Elevator Co. of Pittsburg, Pa.

Some Random Notes on Patterns.

Hexagons, as made in many shops, are not hexagons at all, they only pass as such. A great mistake often made is to attempt to work out a hexagon by spacing the points. The right way is to strike a circle, or turn a diameter the right size across the flats; cut two sides parallel and use the protractor for the other four sides, then go around it and see that all angles are alike, as they will be if the work has been carefully done. If there are several of one size to make cut a template thick enough to serve as a guide for the chisel. Of course anything which can be done on the trimmer, there is no call to do by hand.

In making patterns for hand hole plates I saw the plate to fit curve of inside of boiler, then lay it flat and saw the oval. Saw the plate which fills the hole in the same way. If it is only a rib, saw through and cut the inside out. By this method this kind of a pattern can be cut so that it is only necessary to sandpaper it and round off the inner corner. The man behind the band saw is often a great money saver.

When I have old patterns to alter, which need taking apart and the pieces are to be used again, I use a hack saw to cut them apart. Nails and wood all look alike to it, and this method is cheaper than filing saws.

In making grate bars I use thick shellac for the joints. This lasts as well as glue and does not ooze out and take up the sand. I use a rapping plate of $\frac{1}{8}$x$\frac{5}{8}$ inch, or $\frac{1}{8}$x$\frac{3}{4}$ inch iron across the top, and bend the ends down alongside of the bar and let them into the pattern. These plates must be made to suit the grate bar, but it is quite possible to bend this light iron sufficiently square without heating it. By putting screws through the ends that project downward the pull is sideways on them. And has therefore little tendency to loosen the screws.

There are many patterns on which drawbacks have to be used which could be molded much more economically by using a covering core for the loose pieces and ramming it up in the mold. This is quite possible even where the shape is irregular, as it is only necessary to have the core fit this.

We recently made a balance wheel pattern, 24 inches in diameter, 4-inch face, do-

ing all the work on the band saw. This was a case where the saw had the better of the lathe as far as time is concerned, and as the castings were machined they were sufficiently accurate. We first put the arms together with radial joints, laid them out and sawed them to the line with the draft on them. Next we fitted segments between the arms of the same thickness as the arms, laid out the inside, then took and sawed them with draft and fastened them in. We then struck a circle carefully to build the rim segments to, which were accurately sawed with the proper draft on the inside only. These were then fastened on and a circle struck for the outside diameter, which was sawed through the entire thickness of the wheel. The hubs and prints were later sawed out and put on and there was our wheel made on a band saw. True, it was not a very highly polished job, but amply good enough for the purpose for which it was to be used.

I was recently in the pattern shop of a large works when the foundry foreman came bustling in and said to a man working on a pattern on the bench: "I want that. I have got to get it in to-day." To which the patternmaker replied: "All right, here you are," and handed the pattern to the foreman. As I was waiting for the foreman and knew the patternmaker personally, I began talking to him when he said to me: "See that pile of prints. They all belong to that pattern the foundry boss just took out; he did not ask me if the pattern was done, and as he seemed to want it so badly I let him have it." I afterwards heard that the casting was actually made without any cores, and, of course, was scrapped, but I did not hear who took the blame. Who did it belong to?

I once had a patternmaker who was not a very good workman, and I finally decided to let him go, and sent him to the office for his money at quitting time. I was much in doubt as to whether I could use the last job he did, and so expressed myself to him. The next morning on going to his bench to get the pattern, I could not find it, and after looking around for some time I gave the job to another patternmaker, who made a new pattern. When the workman I had discharged came for his tools, I asked him what he had done with the pattern, to which he replied that as I stated it was not any good he had taken the liberty of throwing it into the stove. I suggested that as he had destroyed property that we had paid him for making, that he should go to the office and refund what we had paid him for this piece of work, but he did not do so, and I did not feel like I wanted to have any trouble about it, but wasn't that rather a funny deal?

If tool rooms are a good investment for the machine shop, why should they not prove the same to the foundry and pattern shop? Gate sticks, gaggers, wedges, clamps, nails, etc., are tools that ought to be kept in a proper place. Then in the pattern shops there are extra saws, planer knives, clamps, glue, fillets, dowels, etc., all of which ought to be kept in one place with someone to take care thereof, as well as to keep all tools in order. An up-to-date pattern shop will have special rigs which should be taken care of. The best molder is one who knows a whole lot about molding. He does not try to know enough to run a saloon or be a politician. He knows a lot about one thing instead of a little of many things. This reminds me of the remark of an old lady to the effect that, while her boy never got to be president, he became the very best blacksmith in that section of the country. Success never caught any man, he had to do all the chasing himself.

J. L. GARD.

Some Records of Sand Pounding with Pneumatic Rammers.

With the exception of a few inches of sand next to the pattern, by far the greater volume of sand necessary for a large mold may be rammed up by anyone who has sufficient muscle to drive this together, so that it will withstand the pressure of the iron. In green sand molding that part of the ramming requiring skill and a delicate touch is done in the six inches of sand immediately surrounding the pattern. When we enter the dry-sand branch of the trade the problem of ramming a mold properly disappears nearly altogether, because with the right kind of a sand mixture and proper drying of the mold it is almost impossible to lose a casting, no matter how careless the ramming has been done, so long as the mold is of sufficient density. That practically no skill is required in ramming up

molds which are dried is shown by the fact that when molders, who have never worked on any other class of work, attempt to do green sand molding, they all without exception prove a failure at the start and have to learn a part of the trade over again.

The ramming of the larger class of molds by pneumatic machines is growing in favor and there is no reason why this method should not steadily gain ground. In the first place, with the exception of green sand molding, there is nothing mechanical about pounding a lot of sand together, proof of which is given in the ramming up of many kinds of molds, from those for water and gas pipes to molds for cylinders, by common laborers. If pneumatic rammers will take away much of the hard work done in connection with ramming up molds, the molder ought to be thankful, for even under the best of circumstances he will do enough of a laborer's work. Just how effective a power rammer will be in green sand molding will of course depend upon the skill of the operator, yet as stated before there is nothing to prevent the greater part of the mold from being rammed up by this method. Certainly after the first course of sand has been rammed in a large cope, the balance may be pounded down good and hard, and if pneumatic power will do this in less time than it can be accomplished by hand, there can be but little use in offering objections.

The Philadelphia Pneumatic Tool Co., of Philadelphia, have for a long time devoted special attention to pneumatic tools for ramming sand, claiming the honor of having made the first hand power rammer and at the present being the only firm manufacturing a power foundry rammer. They say that founders in general are beginning to realize the value of the pneumatic rammer and that the molders, once they learn that these tools remove most of their hardest work, take kindly to their use. To show the advantages of these rammers the Philadelphia Pnuematic Tool Co. quote some of their performances, from which it is learned that at the plant of the Dodge Mfg. Co., Mishawaka, Ind., a split bevel gear of 5 ft.

RAMMING UP A COPE WITH PNEUMATIC RAMMERS.

diameter, was rammed up complete by one man with a pneumatic rammer in six hours against 14 hours by the old method. The Buckeye Malleable Iron & Coupler Co., of Columbus, Ohio, have with a pneumatic rammer obtained 150 drawbars in 10 hours against 48 by hand ramming. At the foundry of the Atlas Engine Works, Indianapolis, Ind., copes and drags, 4 ft. 6 inches square and 8 inches deep, were rammed up in 5½ minutes each, while in the shop of the George H. Smith Steel Casting Co., Milwaukee, Wis., a cope, 8 feet square and 12 inches deep, was rammed up in 55 minutes. Other examples of the efficiency of the pneumatic rammer are mentioned by the Philadelphia Pneumatic Tool Co., the above being a fair average of these performances.

Molding From Half-Patterns.

I am going to call the attention of the readers of THE FOUNDRY to a method of molding half patterns which, though not new to all, is at times a great labor saver, as well as a simple way of handling patterns which are regular in design and not of too complicated a character.

The first and most apparent saving is in the cost of patterns, a very important item in jobbing work, or where but few castings are required from one pattern.

Let us for an illustration take the ordinary pipe casting of any size and of uniform shape, such as T's, Y's and crosses, or any other design, cylinders, and in fact work of endless variety. For this class of castings it is only necessary to make a half pattern. Where such castings differ in detail in the nowel and cope, these pieces are to be left loose and care should be taken to mark them properly so that no mistakes can be made in attaching them to the wrong side of the casting.

When we have the half pattern completed we will obtain the size of the most available flask from the foundry foreman. The follow board should be as smooth and straight as possible and a coat of shellac will not hurt it, especially if it is to be used very often. Let into this follow board two plates, one at each end, to suit the size of the flask, these are to receive a turned iron or steel pin, make a center line as accurately as possible on the follow board, using the pine centers as working points. The pattern is then placed on the board guided by this line, and ordinary wood or brass dowels, the latter preferred, are used to hold it in its proper place. Of course the pattern may be so placed as to best suit the flank and the convenience of the molder.

The flask is to be fitted with plates similar to those with which the follow board is equipped. Loose pins are used in conjunction with the follow board for holding the cope or nowel in the proper place, and the same pins again serve when the mold is being closed.

When the pattern and flask are ready for the molder the nowel can be rammed up and the pattern drawn. This part of the mold may be finished while the cope is being fitted, barred and rammed up, thus saving considerable time to the foundry on large castings and allowing a job to be brought forward with much greater rapidity than through the ordinary method of molding such castings.

The follow board as made after the method here described may be used for many different patterns, and a few boards of assorted sizes will equip a foundry for this method of molding. Skeleton half patterns can be used to good advantage by this method, and in many other ways the system will be found a money saver when properly handled.

JOHN W. GRAHAM.

The Successful Foundry Foreman.

Much has been written by managers of foundries and heads of firms concerning the qualifications a foreman should possess in order to successfully fill the position, with justice both to employer and the workmen in the foundry. From personal observations I would say, that as a rule I believe it to be unwise to take a molder from the ranks in the foundry in which he is employed, and make him foreman of the men with whom he has been associated for years. He is almost unavoidably sure to be biased in favor of his former favorite shop mates, and in my opinion a foreman should, in order to be successful, have no favorites of any kind and thus be able to deal with everyone on the same basis.

I think all intelligent foundrymen will agree with me that in order to obtain the best results, both in the amount and quality of work, the molder should be treated as a being endowed with reasoning powers, and not merely as an insignificant part of an industrial machine or a slave, who has

to be driven to his daily task. I have often observed that some foremen are evidently laboring under the delusion that blasphemy means brains, and profanity, profundity of knowledge. After years of experience I am convinced that a foreman who is kind and considerate to the men under him is the one who obtains the best results for the firm who employs him.

I have observed in foundries many different methods of arriving at the same result. In order that a molder may do justice to his ability as a mechanic and give an equitable return to his employer for the wages paid him, it is essential that he should be furnished, on starting in, with those tools, which is customary for the foundry to furnish. He should be given such things as shovels, rammer, riddles, brushes, etc. When a job is put on his floor the flask should be placed there at the same time, as it is a poor policy to pay a molder to do a laborer's work, such as hunting the yard over to find a cope in one place and a nowel in another, or a bottom board, if one is to be used, somewhere else. All of this takes up the molder's time, which should be devoted to molding.

If the foreman would make it a practice to lay out the work, as far as practicable, one day in advance, instead of waiting until a man is out of a job, he would be in a better position to push the work of the foundry, instead of having it push him. Another thing I have noticed in these days of keen business competition is the antiquated methods in vogue in some of the so-called up-to-date modern foundries. I have in mind one, where nearly every casting is bedded in the floor, no matter how difficult or complicated it may be, instead of making a match for the smaller patterns and a good follow board for the larger ones, as is the case in every shop where the same work is made the year around. In many jobbing foundries the same class of work is made right along, and I fail to see the economy of bedding this in the floor, when by providing the proper facilities an increase of at least 25 per cent in output can be secured. Among the many little leaks which will come in even the best of foundries, I may mention the waste of such foundry supplies as flour, facing, oil, nails, etc., to say nothing of the scrap iron which is thrown on the dump and the coal and coke which is thrown away. JOSEPH N. WHITNEY.

Defective Bearings.

Referring to the item in the January issue relating to defective bearings, would say that this trouble should be overcome by casting the bearing with the journal or face side down. I make hundreds of this class of castings by this method, and never have any trouble. I know it is the custom in most of the foundries I have visited to cast the bearings with the journal side up which gives the gases a chance to accumulate in the face part of the casting, the very section which should be solid. Although Mr. Rogers does not say in what position he molds these castings, I should advise him to make these with the journal side down, and I am sure his trouble will disappear. P. S. BRANCHER.

Defective Bearings.

Mr. Rogers, who in the January issue of THE FOUNDRY mentions some trouble he is having in casting a connecting rod brass for locomotives, says that he makes these of phospher bronze, but neglects to state whether he casts these with the journal side up or down. If he will make these castings, face side down, from a mixture composed of copper 80, tin 10, lead 10 and phosphorus 1.2 and run this mixture into ingots and afterwards remelt it for the castings, running these through a heavy gate on the heavy part, at one side of the bearing, and have the runner about ten inches above the casting, he will quickly overcome his troubles. I prefer a sand not finer than a No. 1 Albany. If anything vent the mold well and pour the metal rather cold. Care should be taken to stir the metal well just before pouring. I believe that by following the method described of molding and gating this casting, that the losses will be extremely small.

PETER W. FALCNER.

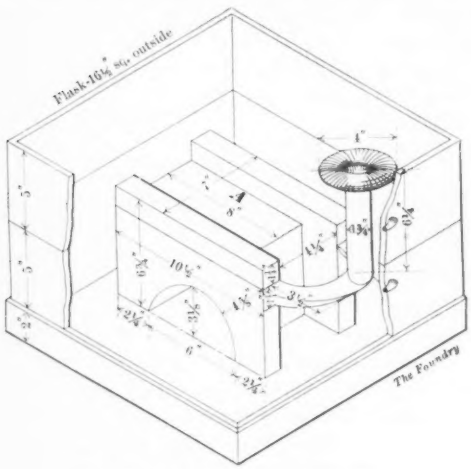
The Laconia Car Co., of Laconia, N. H., is building an addition to its malleable department.

Edward Cochran has purchased the interest of Park Randall in the Sterling Foundry Co., Sterling, Ill.

N. L. Rundio will again enter the foundry business on his own account at Williamsport, Pa. He is now fitting up a plant and expects to begin casting about April 1st.

Locomotive Rod Brasses.

Referring to the January issue of THE FOUNDRY, wherein Mr. Rogers describes some of his troubles with a crank pin bearing, I infer from his description that the holes he speaks of, are shrink-holes, located at about the middle of the bearing, where the casting is heaviest. We are making this class of rod brasses from 15 up to 86 pounds in weight without any trouble whatever. I submit a sketch showing the size of one of the latter brasses and also our



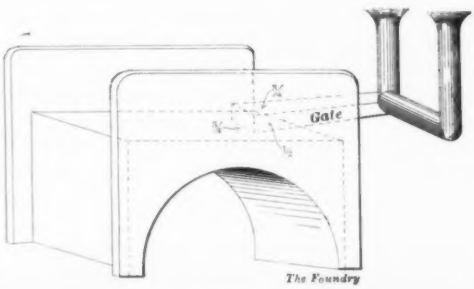
METHOD OF MOLDING ROD BRASSES.

way of gating, from which the reader will note that the larger portion of this pattern is molded entirely in the drag and nothing in the cope but the flanges. The cope is 6½ inches deep and the gate is built up 2 inches more, which gives plenty of head pressure and with the right kind of material, which brasses of this class demand, shrink holes ought not to appear. One reason for gating these heavy rod brasses on the end is to avoid shrinkage along the line at A, as when we have made these castings with gates on the side, we have found that the metal shrinks away at A, or the flange furthest away from the gate, while the flange nearest the gate would not show any shrinkage at all, which proves the correctness of end gating. We use the following formula for rod brasses of all sizes: Pig copper 175, old rod brasses 50, tin 17½, lead 17½.

As to the temperature at which these brasses should be poured, experience is our only guide, although it is well understood that a light casting will require hotter metal than a heavy one, also that dull brass (like dull cast iron) is more apt to make a dirty casting. The following is our method of melting: Melt copper first, and as soon as it commences to boil add the scrap, then cover the furnace and occasionally examine the metal by pushing a red hot rod into it. Should any metal adhere to the rod the metal is not hot enough, while if the rod comes out hot and clean the metal is right and should be taken out. After the crucible is withdrawn from the furnace, stir the metal well, mixing the copper and scrap, then skim clean, next add the lead, then the tin, while some one is stirring all the time; now skim again. By this time the appearance of the metal as near as I can describe it should be that of a bright cherry red; do not pour too slow, because it will soon run sluggish, but as the foundry term is, "in with her." In building up the gate have your funnel large enough so it will conform to the lip of the crucible, as this will give a better chance to pour fast, besides avoiding scrap. L. L.

Defective Brass Bearings.

I believe that if Mr. David Rogers, who has been having trouble in casting a bronze crank pin bearing, will reduce the temperature of his metal, and gate these castings as shown in the attached illustration that he will avoid the trouble of which he complains. To insure a good sound casting all gates should be cut in the cope, and a double or skim gate used. I would suggest using a gate ½-inch thick by ¾-inch wide and between ⅝-inch to ⅜-inch long. My experience in turning out castings of this character has been very satisfactory by following this method of gating and mold-



GATING BRASS BEARINGS.

ing the bearing, face side down. It is also a benefit to use a deep cope so as to obtain considerable pressure. The casting may of course be gated from either side.

L. J. GILLET.

Defective Brass Bearings.

I write this with a view of relieving Mr. Rogers of the trouble he is experiencing in securing perfect locomotive rod brasses. Our method of making these castings, which by the way has given us unvarying success, is to cast them with the bearing surface down, always gating them on one end of the flange, making the gate as wide as the thickness of the flange, and about one-half inch deep, where it joins the casting.

In making these molds we never do any ramming over the bearing surface of the pattern without having at least five inches of sand between the pattern and the rammer. In this way the sand may be rammed firmly without danger of scabbing. For a casting, such as the one shown by Mr. Rogers, our patterns are divided into two parts, the part comprising the bearing surface being made in the drag part of the mold, the other part in the cope; the gate connects with the casting at the middle of the flange, and to insure that these fill up properly, we make the pouring gate, which is one and one-quarter inches in diameter, five inches higher than the highest part of the flange. We pour these castings in a horizontal position, and have never had any trouble with them on account of porosity. They always turn up clean and sound in the machine shop, never developing any defects after being put into use. So much for the making of the mold, although I think that the cause of, and cure for, Mr. Rogers' trouble is rather to be looked for in the manipulation of the metal. Phosphor bronze is a very deceptive metal, because after it has become completely liquified in the crucible, its appearance is the same at all degrees of temperature until in cooling, it suddenly becomes mushy in the crucible and too thick to run freely. The nearer the metal is to the latter condition, the more likely it is to make porous castings, and the hotter this metal is poured, the rougher will the castings be. Therefore in working phosphor bronze, and in order to secure smooth, clean and sound castings, my advice is to watch the metal carefully in the furnace, and as soon as it is all liquified, remove the crucible and pour its contents at once. This method will insure the metal being hot enough and yet not too hot

JOSEPH WHITE.

Shall a Riser be Open or Shut?

It is largely through criticism and arguments that a foundry foreman's attention is called to experiments which may offer him more or less assistance. Some of the more skeptical foremen may think that the subject of open or closed risers does not amount to much, but it has been my experience that we all have more or less to learn along these lines. I have noted Mr. Murphy's criticism of my practice in keeping the risers of a mold open, and intend in this article to defend this and take up other points involved.

Let us say that a boiler which will only stand a pressure of 160 pounds per square inch is not provided with a safety valve or that the outlet is too small to take away a rise in pressure, the result of this would naturally mean an explosion. If the outlets of a mold are not large enough to relieve the pressure within it, explosions will take place just as readily as in a boiler. It is my opinion that a casting of any magnitude which is cast with closed risers and comes out of the sand without showing any defects does so, not because the risers were closed, but because expert mechanics have provided sufficient outlets in one way or another.

Mr. Murphy states that he has seen important and costly castings lost by both methods being used at the wrong time, although he does not give any specific instances which would enable us to pass judgment. A more stringent examination of these losses might have demonstrated that some other cause was back thereof. Of course if a mold was perfectly made, either method would give good results, still, as a general application I believe the open riser is in every case the safest.

The claim that pressure within the mold is essential to sustain the walls and cope of same is equal to making the assertion that it is necessary to support the mold from within. It is my opinion that if a mold is properly made the least pressure brought to bear upon it the better the chances will be for securing a first class casting. With most molding sands a mold may be poured with the riser either open or shut, at least, such has been my experience. The face of any mold perfectly made and cast open will nearly always give a casting perfect on its

face, although it is quite a different proposition from casting a mold with a cope. I really fail to grasp Mr. Murphy's idea of suction in this connection, as from my observations a riser covered with a chunk of clay or a piece of board will be lifted off, which to my mind denotes that instead of there being suction within the mold, we have considerable of a pressure. I will here say that in my original article I did not refer to open sand castings in any way.

I have talked with several foundrymen on this subject and those favoring closing the risers of a mold maintain that this should be done in order to prevent draw-downs or burn-downs. I have seen as many castings drawn down with molds having closed risers as with open ones, and I insist that if a mold is properly made in the first place, we would never be troubled with defects of this character. When we take into account the varying abilities of molders, we do not have to go far to find that some molders have in their molds hard rammed spots, wet and soft spots, which would be liable to cause more draw-downs than an open riser, and it is in such cases that I have experienced the benefits of the latter, when instead of keeping all the pressure in the mold I have relieved this as quickly as possible and when the molten iron reaches these spots there is not so violent an agitation of the metal. As an example take an open sand mold which is hard or wet in spots and unless it is extremely so, the kicking or boiling of the iron soon ceases. Take the same mold covered with a cope, and we are pretty sure to have some fire works, and if the risers are closed the action is sometimes so violent as to lift cope, weights and all in order to relieve the pressure generated in the mold.

As for molding a large kettle bottom side up in green sand this is something I would not be guilty of, unless it was a casting, of which I have seen many made, called a "cow boiler." I have made a great many kettles or acid pots weighing from 10 to 12 tons apiece, bottom side down in loam, and pouring these with pop grates $\frac{5}{8}$x2$\frac{1}{2}$ inches in size all around the top of the casting except four places where I had placed as large risers as the rim would take. I made the runner travel all the way around from the pouring basin, and kept these risers open for two very good reasons; first, if I did not have any risers, how would the air which must necessarily accumulate, while the iron is filling the mold, find an egress? The result would be that just when the mold was about full we would have what I term a block or kick back until the air was liberated. Second, at the point where the kick back or jar would occur, this would at least increase the strain on the binding tackle, and it might result in some part of this giving away, whereas, when I poured these castings with four large risers, leaving these open and having a good flame shooting out of each, I had a first class success and the castings did not show any of the scabs which Mr. Murphy says is the invariable results of leaving the risers open. As for the appearance of dumb scabs, I do not believe one will be bothered with these if a loam mold is thoroughly dried. It has been my experience that these defects are caused by steam coming through the face of the mold. Gases are quite a different thing, however, as these can escape through the face of the mold if this is perfectly dry without any evil results attending this. A. M. LOUDON.

Think it Over.

A founder in Ireland says he would like to have full information in regard to melting with coal in cupolas, instead of coke. This should include the class of coal most suitable, and the amount to be used in bed and subsequent charges. The cupola to be employed is 23 inches in diameter inside the lining; tuyeres are 18 inches above sand bottom. The cupola is provided with four tuyeres, 5 inches in diameter. The air supplied equals about 2,000 cubic feet per minute at 8 ounces pressure. Amount of iron to be melted daily varies from 2$\frac{1}{2}$ to 3 tons. Where should the melting zone be in the above cupola?

The Bath Foundry & Machine Co. has been organized at Bath, Pa.

The Williamsport Clutch & Pulley Co., Williamsport, Pa., has been incorporated, with the following officers: T. A. Thomas, president; N. B. Bubb, vice president; H. A. Bubb, secretary and treasurer. The company has acquired the Crowell Clutch & Pulley Co. of Westfield, N. Y., and the Rundio-Bubb Foundry Co. of Williamsport, and will manufacture a complete line of power transmission machinery.

Beddall Bros. of Tamaqua, Pa., have purchased the Eagle Iron Works from Henry Walter's Sons and will make enlargements for the manufacture of breaker machinery.

Strength of White Iron Castings as Influenced by Heat Treatment.*

BY A. E. OUTERBRIDGE, JR.

In the year 1882 while engaged in metallurgical work at the car wheel foundry of A. Whitney & Sons in Philadelphia, my attention was called by the inspector of wheels to an unusual and remarkable change that had occurred in the chilled or white iron forming the "treads" of a number of wheels poured from one heat. This change was first observed on removing the wheels from the annealing pits. It was customary for the inspector to prove the hardness of the chilled treads by testing them with a cold chisel all around the "throat," or place where the tread joins the flange. On this occasion he found a number of wheels which were quite soft on one portion of the rim, extending the entire width of the tread for a length of 6 or 7 inches, while on either side of the soft spots the chilled tread was so hard that the steel chisel slipped over the surface without biting. In order to study the nature of this singular occurrence I caused the wheels to be broken through the soft spots, so as to examine the fracture, and I found that the white iron (chilled iron) had been changed into perfectly gray iron, evidently after the wheels had been cast. The change was not equally well marked in all of the wheels, and the soft spots were smaller in area in some cases than in others; but in all the dividing line between the white portion and the gray portion of the chilled tread was sharply defined.

It is perhaps necessary to state that in the establishment where these wheels were cast, it was customary to pre-heat the annealing pits by means of soft coal fires before the wheels were lowered into them, the flames passing through the pits or ovens. The rule was to close the dampers just before the pits were opened to receive the red hot wheels, in order to shut out the flames. After careful investigation, I found that through an oversight, the dampers of the annealing pits had not been closed and the flames from the fires impinged upon the surfaces of three or four red hot wheels in the lower part of each pit, causing a complete change of the carbon from the combined form to the free condition wherever the flames touched the casting.

Drillings were taken for analysis from the soft parts of the chilled treads and also from other parts of the wheels, as well as from test pieces poured from the same ladles of iron. The analyses showed two things—first, that the car wheel iron was of normal composition; second, that the only change in the metal of the annealed or soft portion of the "chill" was in the condition of the carbon, which had been converted from chemical combination with the iron into an amorphous form of graphitic carbon, or, to speak more guardedly, I would prefer to say simply into the form of "free" carbon, for there are reasons for believing that the carbon in this case is not in the same condition as when it exists normally in gray iron.†

Specific gravity tests showed that the gray cast iron resulting from this accidental heat treatment of white iron differed materially in density from the normal gray iron forming the unchilled parts of the same castings. The specific gravity was about 7.80 as compared with specific gravity of about 7.20 for the normal gray metal. A cubic foot of the gray iron produced by this annealing process, therefore, weighed about 37.5 pounds more than a cubic foot of the normal gray iron of the same casting. It was noticed that the fracture was of much finer grain than normal gray iron, and "chips" or drillings of the annealed chilled iron differed greatly in appearance, size and shape, from the chips or drillings of the normal gray iron made with the same drill.

Several metallurgists to whom the pieces of the annealed chilled iron were exhibited offered a plausible explanation of the phenomenon, saying that it was merely an accidental version of the white iron into malleable iron and therefore presented no novel features. The analyses quickly showed the fallacy of this theory, for the total carbon was the same after annealing as before annealing, being about 3½ percent in each case, while in the ordinary conversion of white iron castings into malleable iron, a large part of the carbon is removed by the oxidizing material in which the castings are imbedded when subjected to heat treatment, and this conversion of white iron into

*Read at the Atlantic City meeting of the American Section of the International Association for Testing Materials.

†"Through purely chemical methods four conditions have been detected: 1. Graphite or free crystallized carbon, not acted on by acids even when concentrated. 2. Graphitic carbon or 'temper-carbon' which is also in a free state and unaffected by acids, but presenting an amorphous appearance. 3. The carbon of the carbide of iron (cement carbon) forming a definite compound, acted upon by concentrated acids but insoluble in diluted cold acids. This carbide answers to the formula Fe^3C. 4. Hardening carbon, which appears to form a solid solution with the iron (or which is perhaps present as a compound dissolved in the iron) and which is acted upon by cold, dilute acids."—From "Notes on the Chemical Constitution of Cast Iron and Steel," by A. Carnot and E. Goutal, *Annals des Mines*, October, 1900.

malleable iron can only be successfully accomplished on sections of metal of moderate thickness, say less than 3 inches.

CONVERTING WHITE CASTINGS INTO "STEEL."

Although this accidental discovery of annealing of white iron on the treads of car wheels was regarded as an interesting and novel one at the time, the only practical use made of it was to guard against a repetition of the accident in the annealing pits of the car wheel works with which I was at that time connected. After the lapse of several years I was called upon to investigate in a professional capacity, and in the interest of some prospective investors, the merits of a new process of converting white iron castings into steel and received from the manufacturer a number of axes, hatchets and other edge tools, which had been cast in white iron and subsequently converted into a metal having evidently many of the qualities of steel.

Without describing in detail the process to which these white iron castings had been subjected, I may say briefly that they were placed in the muffle of a furnace together with a chemical compound claimed to be necessary to the conversion of the cast iron into steel. Common salt and crude hydrochloric acid were two ingredients of this compound. The similarity between this process and the accidental over-annealing of the car wheel (with consequent change of the condition of the carbon) suggested to my mind that the chemical compound was probably unnecessary and that the secret consisted solely in the heat treatment, and I so advised my clients.

The conversion of white iron castings into dense gray iron having high tensile strength (approximating that of certain grades of steel) capable of being hardened and of taking a sharp cutting edge, is no longer a secret and is carried out on a commercial scale in a number of establishments. While I cannot speak positively, I am of the opinion that the heat treatment alone is now relied upon to produce the desired results. These products are not steel castings, though sold in some instances under the name of steel; neither are they malleable iron, but they may be described as occupying a peculiar position midway between cast steel and cast iron.

DIFFERENCES IN WHITE IRON CASTINGS.

Having given a resume of the history of this process of heat treatment of white iron castings, I will state a few facts regarding certain interesting features, including tensile strength of this converted metal. In the early experiments I found that there was a vast difference in white irons. Some samples remain white and hard after having been soaked for many days in the annealing furnace, even when subjected to the highest temperature below the melting point of the metal, while other specimens of white iron of the same dimensions yielded readily to the heat treatment and became completely converted into gray iron in a few hours at a comparatively low temperature, analyses of the different samples revealed the chief cause of this difference. It depends almost entirely upon the presence or absence of silicon in the white iron, castings containing only a trace (or a few tenths of 1 per cent) of silicon cannot be successful treated, for only a partial change of the combined carbon into free carbon takes place, even after prolonged treatment at the highest temperatures. Thus, in one of my tests two white iron bars about 2 inches in diameter and 12 inches long were placed side by side in the furnace and subjected to the heat treatment for eight hours. One of the bars containing about 0.15 per cent silicon, was cast in sand; the other, containing 1.25 per cent silicon, was cast in a heavy iron mold, because, if cast in sand it would not have been white iron. Both bars were equally brittle, equally hard, and perfectly white before treatment. A slight tap with a hand hammer was sufficient to break them. When removed from the furnace after eight hours' soaking at a high heat, and allowed to cool in the air, the bar containing 0.15 per cent silicon was unchanged in the appearance of the fracture, while the bar containing 1.25 per cent was almost gray. It was soft and so ductile that a small piece of it was flattened out under the steam hammer while cold. The bars were then returned to the furnace, subjected to the same heat treatment for six hours longer and allowed to cool, as before. No visible change occurred in the low silicon bar while the other bar was completely converted into gray iron with a uniformly fine grained fracture and dark gray color. This bar was turned in a lathe to a diameter of 1.129 inches (giving an area of 1 inch) and provided with threaded ends for the grips of the testing machine. The metal was readily machinable and the surface was free from "graphite pits" so characteristic of ordinary soft gray iron when machined. This bar was pulled on a testing machine of 100,000 pounds capacity, and the actual load at failure was 47,760 pounds. The elongation and reduction of area were not measured, but were

very small. A number of similar tests were made on different sized bars giving tensile strengths ranging between 40,000 pounds and 50,000 pounds per square inch, but manufacturers equipped for making converted castings in this way have obtained much higher records than these.

OTHER SIMILAR EXPERIMENTS.

The literature upon this novel and interesting subject is very limited, but some valuable papers have been published and it is my desire to present herewith a resumé of the work done by several well-known metallurgists in this country and in Europe.

At the meeting of the Mining and Metallurgical Section of the Franklin Institute, held June 9, 1897, Mr. Charles James described "A Special Process for Treating Cast Iron," the following account of which appeared in the Journal of the Institute of July, 1897: "White iron with approximately 2.40 per cent combined carbon and 0.4 per cent graphitic carbon, is used for the purpose. The castings are placed in a muffle furnace, in which they are subjected to the action of a secret composition (said to be a powerful volatile oxidizing agent) and maintained at a temperature slightly below fusion for five or six hours. The product may be forged and tempered and shows a remarkable increase in tensile strength. The total carbon in the product seems to be the same as in the untreated iron, but combined carbon has been substantially altered into a finely disseminated uncombined carbon.

Doubts were expressed in the discussion which followed, whether the result was not due entirely to the annealing, rather than to the "medicine." The prolonged annealing was thought to be a sufficient explanation of the facts. The process is in commercial operation in a large foundry in Philadelphia, producing hatchets, hammers, etc.

The journal of the Franklin Institute for September, 1900, contains an article by Mr. James on the same subject, giving abstracts of results obtained from daily business practice, extending over a considerable period of time, but though these investigations were made for the guidance of commercial operations, they seem to be of sufficient metallurgical interest to justify their presentation. Mr. James states that the irons used were all of Bessemer quality, the melting charges consisted of a mixture of gray and white irons of which the following is an average analysis:

	C. C.	G. C.	Si.	Mn.	S.	P.
White iron	3.50	.50	.50	.20	.08	.08
Gray iron	.50	3.50	1.30	.30	.02	.03

"The composition of the charges was regulated by the silicon content, which was made to vary from 1.20 to .90 of 1 per cent, the average chemical composition of these mixtures being:

Carbon	3.40 to 3.80	per cent
Silicon	.90 to 1.20	per cent
Manganese	.35 to .20	per cent
Sulphur	.05 to .04	per cent
Phosphorus	.04 to .03	per cent

"The iron was sometimes smelted in a cupola, but generally in an air furnace. The following is the average chemical composition of a large number of castings:

C. C. 3.02 G. C. .47 Si. .78 Mn. .12 S. .05 P. .04

"The weight of the castings ranged from half an ounce to 2,000 pounds and over. The time required to effect the carbon change varied from 3½ to 10 hours from the time the castings had attained their full temperature.

"The temperature at which the change takes place in castings of this description lies between the melting point of silver and copper, and may therefore be approximately taken at 1,850 degrees F.

"The change of carbon in castings subjected to the annealing process, though gradual, is coextensive throughout any given cross-section of the casting; no hard center or core of white iron, surrounded by softer metal, having ever been observed in any of the castings examined. No matter at what period the annealing may have been arrested, the total surface of any fracture always showed a similarity in the condition of the metal, provided the composition of the metal was homogeneous and the heat treatment had been applied equally to all parts of the casting."

This agrees perfectly with my own observations and it constitutes, moreover, a very interesting and important feature, differing from malleable iron castings where a progressive change occurs; the central portion of a malleable iron casting is sometimes found to be practically unaffected by the heat treatment as to the total carbon and, unless the casting is very thin, the conversion is, in fact, never uniform throughout the section. The same law of progressive change in the proportion of carbon obtains in "case-hardening" of steel, though the operation is the reverse, i. e., carbon is imparted to, instead of withdrawn from, the metal.

The following analyses before and after annealing, given by Mr. James, show very clearly that the only change effected by the heat treatment is in the condition of the carbon:

	C.C.	G.C.	Si.	Mn.	S.	P.
Before annealing...	2.60	.72	.71	.110	.045	.039
After annealing....	.82	2.75	.73	.108	.040	.039

Mr. James says: "I wish, however, to say that, although for convenience the term graphite is employed in stating the analyses of these castings after annealing, the condition of the carbon differs very materially from graphite, either as found free in nature or as solidified out from gray iron during cooling. The carbon thus formed is evidently identical with what Ledebur has called 'tempering graphite carbon' and is an allotropic form of graphite, and not merely amorphous carbon."

Mr. James states that both silicon and manganese exert great influence upon the carbon during the annealing process. "The presence of silicon being a necessary condition to the carbon change. In low silicon iron it is very difficult and, in some cases, impossible to effect the carbon change no matter how long the iron is exposed to the heat treatment."

My original investigations did not indicate that manganese possessed any very marked influence on the carbon change in this process, though I am well aware that manganese, especially in the form of ferro-manganese, added in very small quantity to molten car wheel iron, exerts a marked effect upon the chill and on the relative proportion of combined and graphitic carbon. It is a fact, however, that low silicon irons are usually low in manganese and this, I think, is the reason why Mr. James was led to infer that manganese facilitates the carbon change in the annealing process. Mr. James gives no records of strength of the white iron castings converted by him into gray iron by annealing.

EFFECT OF VARYING PROPORTIONS OF SILICON.

Before proceeding to the consideration of other features I desire to call attention in passing to one point which may, I think, have practical value, especially in the manufacture of chilled cast iron car wheels. It has long been known that wheels having approximately the same depth of chill on their treads wear very differently in service, some retain their hard surface until the white iron tread is gradually worn away evenly all around the wheel. Others become soft in spots very quickly, necessitating removal from service long before the wheel has lived its proper life.

We know that the action of the brakes on the wheel heats the tread and it seems to me not unlikely, from the foregoing observations that when the silicon exceeds a certain amount, say 0.7 per cent in any wheel, a similar kind of annealing of the white iron tread of the wheel may occur from the heating action of the brakes, thus changing the condition of the carbon, at least to a partial extent, and causing the chilled tread to become much softer than would happen under similar conditions, where the wheel is made of metal containing less silicon.

The following conclusions are reached. They are announced didactically as laws and may be so accepted:

1. The separation of graphite commences at a lower temperature as the percentage of silicon is increased in the iron.

2. The separation of graphite having begun, it continues at a lower temperature than that required to commence the reaction.

3. At a constant temperature the separation of graphite proceeds at a lower speed according as the temperature is lower and the proportion of silicon is less.

4. The proportion of combined carbon which corresponds to the equilibrium at a given temperature diminishes when the silicon is increased.

The brochure of Messrs. Charpy and Grenet is embellished with several fine micro-photographs showing very clearly the micro structure both before and after treatment. No records are given of tensile strength of the treated specimens and, as it is stated at the beginning of the paper that the white iron specimens were obtained by pouring the metal into cold water, tensile tests could not be made, for the samples were presumably merely small irregular lumps which are far inferior, I think, for such purpose, to the uniform ingots of white iron obtained by pouring high chilling metal into heavy iron molds. I have found it easy in this way to obtain ingots of white iron of any desired length and of suitable sections, the dimensions depending, of course, upon the proportion of silicon contained in the iron poured. By using a flat ingot mold made of thick cast iron plates, I have obtained flat ingots 5x8x½ inches of perfectly white iron and containing as much as 2 per cent of silicon. These high silicon white iron ingots or plates are very readily converted into gray iron by annealing.

CONVERTED WHITE IRON AND MALLEABLE.

Although I consider it a misnomer to call

castings such as hatchets, axes, etc., made from white iron changed to gray iron by heat treatment and subsequently hardened on cutting edges, steel castings, they are certainly very different from true malleable iron castings or from ordinary gray iron castings, possessing qualities more closely resembling steel.

When the process is carefully and intelligently conducted the product is reliable, but prejudice has been developed by the fact that some of the manufacturers have not thoroughly understood the underlying principles and have turned out castings imperfectly converted. It is, of course, much easier to make perfectly white iron castings from metal very low in silicon, but as I have here shown, such metal is unsuitable for the subsequent conversion by heat treatment into gray iron, and this I believe to be the main cause of many failures.

So far as I know there are no valid patents covering this process of heat treatment of white iron castings for conversion into dense gray iron of high tensile strength, capable of being forged and tempered, by simply changing the condition of carbon without removing any of the original component elements.

As the process of converting white iron castings into malleable iron is well understood and has been carried out on a large scale for many years, I have not thought it necessary to allude to this product further than to show that it is radically different from the converted white iron castings containing all of the carbon of the original metal before the heat treatment. Good malleable iron castings are very ductile and may be bent almost double, and twisted, while cold, without breaking, if the section is light enough to permit of complete malleableizing; but annealed white castings cannot be thus bent even when completely converted into gray iron.

It is true that since the discovery of the fact that hard and brittle white iron castings may be changed by simple heat treatment into strong soft gray iron castings, some makers of malleable castings modify their old methods and practically rely upon heat treatment to anneal their castings without packing them in oxidizing material as formerly, to remove the carbon, but such heat treatment does not and cannot make true malleable iron castings. In other respects, also, converted white iron castings, containing all of the original carbon, differ in physical properties from malleable iron castings in which a large portion of the carbon has been removed.

In conclusion I would say that if we can eliminate the false name of "steel" which has been given to converted white iron castings a distinct advantage will have been gained, for I believe that the new metal is worthy of taking a special place in the metallurgical arts and I anticipate extended practical applications of the process as knowledge of the proper methods of heat treatment and of the valuable properties (as well as the equally marked limitations) of the metal shall become better known and appreciated.

Cracked Crucibles.

Much has been written about the annealing and proper treatment of graphite crucibles in order to prevent their cracking when in the fire, but little or nothing has been said about their splitting from other causes.

One of the most frequent and, indeed, one which is usually laid at the door of the crucible maker, is the cracking produced by the expansion of the metal in the crucible. I do not mean by this that all cracks in the crucible are produced by this cause or that all classes of metal will cause it. It is particularly true of metal in large masses, such as copper ingots, and is more apt to occur on the first heat in the morning when the crucible is cold.

It is human nature, I presume, on the part of the melter to desire his metal to melt as rapidly as possible, and, therefore, if he is not dependent too much upon other influences, to finish his day's work in a shorter space of time. For this reason, when the first heat is started in the morning he carefully wedges the copper or other ingots into the crucible (indeed, I have seen them driven into tight places with a hammer) so as to get as many as possible in the pot to melt down before the others are added. Copper being an excellent conductor of heat, and, on account of the flames from the fire playing around the tops they become heated much more rapidly than one would expect, soon begin to expand and crack the crucible. Were the crucible red-hot the danger of cracking is very much lessened, for the clay which the cible contains becomes plastic so that when the metal expands the crucible possesses a certain amount of flexibility. This explains the fact that the majority of crucibles are cracked on the first heat when everything is cold.

There are several influences which tend to prevent this expansion cracking, and one, particularly, is the use of skeleton scrap, chips, etc. These materials act as a sort of cushion or

spring and so prevent the rupture of the crucible. Neither is the accident so liable to happen if all scrap is used as when large masses are employed, especially copper ingots, and these resting horizontally in the pot.

The melter, I am sure, will not intentionally pack the crucible with ingots so that there is liability of rupture, but does it through not understanding the laws of expansion of metals by heat. An ocular demonstration of this phenomenon would undoubtedly aid him in understanding the subject. In conclusion, let me say that especial care should be used upon the packing of the ingots for the first heat or when the crucible is cold. Place them in the crucible vertically and so that they will lie loosely. Under no consideration place an ingot horizontally for, even though it may at first lie loosely, the melting of the metal below it allows it to sink down to a position where the diameter is less and thus produce wedging. I think if one gets into the habit of placing the ingots vertically or, perhaps, diagonally there will be fewer broken crucibles in the foundry or casting shop.—Erwin S. Sperry in *Aluminum World*.

Among the Foundries.

The Coleman Hardware Co., of Morris, Ill., will extend its foundry so as to make room for about twenty more molders.

The L. W. Gunby Co. of Salisbury, Md., has plans under way for the building of a modern machine shop and foundry, work upon which will be started shortly.

It is announced that the Guerber Engineering Co., of Bethlehem, Pa., will add a foundry to its plant.

The Watkins Machine & Foundry Co., of Hattiesburg, Miss., has increased its capital stock to $50,000.

Hunt & Hunt of San Diego, Calif., will build an iron and brass foundry to be operated in connection with their present machine shop.

The plant of the Columbia Foundry & Machine Co., at St. Joseph, Mo., has been purchased by G. D. Berry, who will make additions thereto and install new equipment. The new company will be known as the Berry Foundry & Mfg. Co., and will have as officers: G. D. Berry, president; W. C. Ransom, secretary, and E. F. Dengler, superintendent.

The title of the Gray-Blaisdell Co., Bradford, Pa., will shortly be changed to the Blaisdell Machinery Co. It is going extensively into the manufacture of gas engines, and in furtherance of this expects to erect a foundry in the spring.

Plans have been completed for an extension to the foundry of John Toler, Sons & Co., Newark, N. J., to be 100x25 feet in dimension.

The Youngstown Bronze Co., Youngstown, O., will erect a foundry building 85x150 feet and will engage in the manufacture of iron as well as brass and bronze castings. The officers of the company are: Grant Jones, president; W. H. McMillan, secretary and treasurer; J. W. Long, manager.

A new foundry is to be built by the E. D. Jones & Sons Co., of Pittsfield, Mass.

The National Brass Mfg. Co., has been incorporated at Rochester, N. Y., by Wm. H. Wray, Jas. H. Teats and Chas. F. Wray.

The Bellingham Bay Engineering & Machine Co., has been incorporated by A. McLean, J. M. Witter and C. McLean to build a plant at Fairhaven, Wash. This is to include foundry and pattern shop.

At Pittsburg the Sommerfield Machine & Mfg. Co. is being formed to take over the machinery business of Rudolph S. Sommerfeld. A large modern foundry and machine shop is to be erected in the Pittsburg district, and when this is done the present plant will be abandoned. All the present shops, machinery, gears and tools are manufactured, and these lines will be continued in the new shop on a larger scale. Rudolph G. Sommerfeld will be president and John Bucock will be secretary and treasurer.

The new foundry now under construction by the Filer & Stowell Co., of Milwaukee, Wis., will contain a 15-ton open-hearth furnace for the manufacture of steel castings in addition to the equipment for the gray iron foundry.

The Duplex Mfg. Co., will erect a foundry 70x140 feet at Elyria, O., for the manufacture of drainage supplies.

The Fort Worth Foundry & Machine Co., Fort Worth, Texas, will increase its foundry capacity.

The Lansing Foundry Co., Lansing, Mich., has been incorporated with a capital of $20,000 to operate a general foundry.

The Gleason Works have been incorporated at Rochester, N. Y., with a capital of $325,000 to take over and operate the plants of the Gleason Tool Co. and the Genesee Foundry Co.

Personal.

Mr. David Spence recently resigned his position as superintendent of the Perkins Machine Co.'s foundry at South Boston, Mass., to become general superintendent of the Greenlee Foundry Co., Chicago. Two foundries are operated by this company, and Mr. Clarence Evans, as foreman, will look after the shop devoted to heavy castings, while the other foundry will be in charge of Mr. Burt Wood.

John C. Burns has assumed the position of foundry foreman with Abendroth Bros., Port Chester, N. Y.

Mr. Frank A. Johns, formerly connected with the Enterprise Foundry, Allegheny, Pa., has been engaged by the American District Steam Co., as foreman for their new foundry, now under construction at North Tonawanda, N. Y.

L. H. Boutelle has accepted the position of foundry foreman with the Lamb Knitting Machine Co., Chicopee Falls, Mass., made vacant by the resignation of George W. Briggs, who goes to the Confectioners' Machinery & Mfg. Co., of Springfield, Mass.

Joseph Beltzer has been selected as manager of the Somerset Mfg. Co., Somerset, O.

Deaths.

William H. Thompson, formerly a well-known iron founder of Rock Island, Ill., died Jan. 18 at the age of 86. He was born in Glasgow, Scotland, and came to the United States in 1848, working at several places until 1856, when he established a foundry in Rock Island, from which he retired fourteen years ago.

Henry P. Deuscher died at his home in Hamilton, O., Jan. 20, in his 74th year. He was the founder of the H. P. Deuscher Co., and a number of other enterprises.

Dan O'Neil, for many years foreman of the foundry department of the Union Iron Works, San Francisco, Calif., died recently, aged 70.

Theodore Ahrens, Sr., founder of the Ahrens & Ott Mfg. Co., Louisville, Ky., died January 19, at the age of 77. Mr. Ahrens was born in Hamburg, Germany, and came to this country in the early fifties.

The Gohmann Bros. & Kahler Co. of New Albany, Ind., has been formed with the intention of engaging in the manufacture of stoves and hollow-ware.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and Using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

SULPHUR AND COKE.

Letters received from various localities indicate great trouble from excessive sulphur in coke. One founder reports hard castings, but complains more especially of gas producing nausea and dizziness among the men and wants to know of some practical means of artificial ventilation. Another founder finds his castings hard and full of blow holes with silicon near 3.00 per cent and one had castings so hard that they could not be drilled and iron which was poured into the pig bed was nearly white.

I have known of other cases where iron was hard for one day and soft the next with the same iron mixture. In one of these cases I requested that a sample of the iron be sent me for analysis. When there are so many complaints there is some probability that the sulphur in the coke did the damage.

In the past I have been inclined to doubt the stories of sulphur in coke doing any harm and I have thought that the almost universal superstitution regarding sulphur in coke among founders would account for this. I have even thought that it was impossible to make gray iron take enough sulphur coke to materially influence the castings. Lately, however, I have found that under conditions that seemed exactly similar, at one time the iron would, and at the other it would not, absorb sulphur, and therefore we must provide for the exceptional times when sulphur is absorbed.

Is there any way to prevent sulphur in coke from entering the iron? A small quantity of ferromanganese charged in the cupola will carry off some of the sulphur, 40 to 60 lbs. of pure limestone to the ton of iron charged into the cupola, or better, fluor spar, oyster shells or chips of marble will take away sulphur. Wetting coke after it is weighed and before it is charged is said to do some good. A good many years ago I saw white-wash as thick as cream, with one-fourth as much salt as lime, thrown onto the coke after it was in the cupola. A pailful was used to each 300 lb. charge of coke. The lime went into the cells of coke and the

salt made it set so that the blast could not blow it away. It was however found that increasing the limestone did as much good as the more expensive lime wash.

I was just going to say that there was no reason for the coke makers to send sulphur coke to founders, because they have plenty of other customers that can use this, but I have just seen a letter from a large producer of coke which says that with the present state of the railroads they cannot get any better coal and that conditions will soon be much worse and therefore the founder must learn to use what coke he can get.

THE MYSTERIOUS IN THE FOUNDRY.

Is there any other business that has so much that cannot be accounted for? In one foundry the iron was short at the end of the heat and the scrap charged later was too dull to pour. It was thought that the molders had not calculated correctly in giving the amount that each needed and everything was uncertainty the next day, when about noon it was found that 3,000 pounds which should have been allowed for one part of the shop, had not been added in the day before.

One day the iron was dull during the latter part of the heat with no conditions changed. Four hundred pounds extra coke was sent up to be distributed among the last charges. The foreman happened along just after the first iron was in and found that all of this coke had been added to the bed. If the iron had been dull again this day, it would have been a mystery.

A day or so ago I ordered test bars taken from two cupolas, as a slight change had been made in the charges of one.

The molder made two sets from one cupola. The bars were alike which led to inquiry, otherwise it would have been a mystery that both mixtures gave the same result.

Most mysterious foundry experiences are caused by mistakes of some one.

Steam Jet Cupolas.

The arrangement of pipes of the Grenier cupola recalls to mind the variety of methods I have seen for admitting steam jets at various points to cupolas for the purpose of improving the melting or the quality of the iron. This feature of melting has been pretty thoroughly tried in this country in years past and a number of patents have been taken out for it here and in Canada, none of which have ever come into general use, although great claims have been made for them, both as to economy of fuel and improvement in quality of iron, the inventor of one of these devices, I saw in operation some twelve years ago, going so far as to claim he could produce an iron from a cupola having all the qualities of malleable iron.

This device I found upon investigation to simply involve the putting a jet of steam into the cupola, at the tuyere with the blast, which only amounted to putting that much water into the cupola and had no effect upon the quality of iron, so far as I could see, and certainly no malleable iron was produced in the heat I saw melted.

I made a series of experiments in melting in a cupola with steam, with and without blast, some twenty-five years ago; a detailed account of these experiments is not necessary for they proved a complete failure so far as saving fuel, making hotter iron, or improving quality of iron is concerned, although I was under the impression at the time that some improvements had been effected; but these, like many other results obtained in experimenting with cupolas, were deceptive and are due rather to careful management of the cupola than to any actual benefit derived from the steam.

Since making these experiments, I have met a number of men who have made similar investigations in this direction. Among these were the late Thos. Glover, who, when foreman of the large foundry of Morris & Tasker, made extensive experiments with steam in their large cupolas, using wet and superheated steam, putting this into the cupola at the tuyeres, and above and below the melting zone.

Mr. Glover kept an accurate record of these experiments, a copy of which he offered to furnish me, but as they were made years ago, when he came to look for the records these could not be found and had either been destroyed or left with the firm in whose foundry they were made and could not be obtained.

That the results of these experiments were not satisfactory is shown by the fact that Morris & Tasker did not continue the use of steam in their cupolas, and when Mr. Glover engaged in business for himself, as the firm of Glover Bros., he did not apply steam to their cupolas.

From what I have observed in melting with wet and superheated steam I have concluded that the passing of steam into a cupola amounts only to the placing of a certain

amount of water therein, and this may be accomplished in a more economical way than with steam.

By placing a small water jet at each tuyere, the water may be atomized and carried into the cupola with the blast, and by placing one or two gunney bags over the inlet of a blower and keeping them damp with water, moisture may be added to the blast and carried into a cupola.

But probably the best way to accomplish this is to wet coke before charging. Years ago it was the common practice of founders to let their coke lay out in all kinds of weather, and in dry spells to wet it with a few buckets of water before charging, upon the theory that wet coke made hotter iron than dry coke.

From my observation of the use of steam in cupolas, I am of the opinion that as good results may be obtained from admitting moisture to the cupola in any of the ways outlined, as from steam generated in a boiler and conveyed to it by pipes and that no visible benefit can be derived through the use of steam in any way.

EDWARD KIRK.

Aluminum Bronze Valves.

Among the first uses of aluminum bronze was its employment in the manufacture of valves and fittings for the paper industry. In the sulphite process of making wood pulp the following method is employed:

The fumes of burning sulphur are drawn through slacked lime until supersaturated. This solution, called sulphite liquor, is mixed with wood chips and the whole mass cooked or digested.

It is the so-called sulphite liquor which troubles the pulp manufacturer, and early in the history of this important industry its corrosive action was fully appreciated. The valves used were, of course, those made of the usual steam metal, and their life was quite short. In seeking a substitute for this material aluminum bronze suggested itself, was tried, and found to be quite a success. The sulphite liquor does not appear to corrode this alloy nearly as rapidly as the copper-tin-zinc alloys, although there is a slight action which sooner or later, of course, destroys the valve. The action is so slow and, moreover, so uniform that aluminum bronze appears to be well suited for the purpose.

While aluminum bronze resists the action of the sulphite liquor in such a manner that a large consumption was expected, the technical obstacles which appeared in the manufacture of valves and fittings retarded its use to such an extent and increased the cost so that, in spite of its value, little if any is used in the paper industry at the present time.

The difficulty experienced is the one always encountered in aluminum alloys, viz., leakage when pressure is applied. This phenomenon is caused by the film of oxide of aluminum intermingling with the metal and being drawn into the mold along with it. When pressure is applied the liquid finds its way out through this oxide; indeed, it actually seems to act as a channel through which the liquid can flow. Were it not for this one difficulty aluminum bronze valves would probably be extensively used.

The early attempts to cast an aluminum bronze valve were conducted in the manner of making steam metal valves. A small gate, no risers, and hot pouring all tended to produce a casting of no value at all. The valve was found to be dirty, full of blowholes, cracked and drawn in the corners, and it invariably leaked like a sieve under a slight pressure.

It was soon found that aluminum bronze had remarkable running properties, and that it could be poured quite "dull." This procedure partially eliminated the difficulties, but not all. The dross or oxide was yet present, and blowholes existed; the same cracks and drawholes also appeared. Risers placed on the heavy portions (and large ones they must be) rendered the casting free from draws and cracks. Suitable skim gates and casting with a horn sprue gave much sounder castings, but as yet no way has been found to entirely eliminate this oxide film. Blowholes may be avoided by carefully melting in the fire, and as soon as melted pouring into the mold. "Soaking" in the fire and overheating invariably produces them.

In attempting to market an aluminum bronze valve the writer was obliged to use a pattern giving a very thick body in order to prevent leakage, and even then a large percentage were "wasters."

Another feature which militated against their use is the necessarily slow speed of the machines which finish the valves. Unlike steam metal valves lead cannot be used for rendering the alloy free cutting, and consequently the machine must be run at a slow speed. The cost of machining is, therefore, excessive. From the experience of the writer the same speed should be used in machining aluminum bronze that would be used for soft steel or iron. One

can readily understand, therefore, the high cost of finishing these articles.

On account of the high tensile strength of aluminum bronze (over twice that of steam metal) a valve could be made, were it not for the intermingling of the oxide, quite thin; even thinner than the cheap steam metal valves now found on the market.

The fact that aluminum bronze is a valuable material in the sulphite industry is not generally known, and undoubtedly some one will eventually succeed in solving the casting problem and reap the harvest which he should. At present the cost is the main feature against its adoption.

A sulphite manufacturer, who was one of the pioneers in the use of aluminum bronze in the sulphite industry, writes the following unsolicited testimonial:

"We have used cast aluminum bronze in our sulphite mill with excellent results. Beginning with a single valve, we have extended its use until all the valves about our digestors and some of our gas pipes are of this material. We propose to adopt it for our digestor connections. Its cost, however, is so excessive that it is an open question whether the ordinary bronze fittings are not cheaper, although they require constant replacing. Were the cost not so high it would certainly be expedient to use the entire fittings of this material."

The writer has repeatedly made castings weighing some 1,500 pounds for the above manufacturer, but under exceptionally trying auspices.

For the alloy the usual 10 per cent aluminum bronze was invariably employed and no difference in casting properties can be detected in any of the mixtures. For the reason that it is the strongest alloy the 10 per cent mixture is used. This is made by melting 90 pounds of copper under charcoal and adding 10 pounds of aluminum. The whole mixture is stirred with a plumbago stirrer, so as to thoroughly mix the metals.

One interesting feature of the leakage of aluminum bronze valves, when pressure is applied, has been noticed. In case a valve does not show a leakage at a low pressure, say 150 to 300 pounds per square inch, it will stand an enormous one, i. e., 10,000 to 20,000 pounds per square inch, showing that the metal is like the child in the nursery rhyme, i. e., "When it's good, it's very, very good; but when it's bad it's horrid."—Erwin S. Sperry, in *Aluminum World*.

Marking Castings.

One of our subscribers asks us for a material which can be used to mark castings for shipment and not be liable to rub off if these get wet. It should dry quickly and preferably be white.

Wake Up, You Eastern Makers of Wooden Molds.

The superiority of Western foundries over Eastern concerns was shown, last night, when the Ellwood Iron Works completed a casting for a tinplate factory in Pennsylvania that had baffled the efforts of many iron works in the Eastern States. The cast was successfully made in especially designed molds constructed by the foreman of the local plant.

Wooden molds had been tried in Eastern foundries and sprung under the weight of the metal, seven tons of iron being required to make the casting. Iron molds were made at the Ellwood plant and held the hot metal without difficulty. The big piece of iron will be shipped to Pennsylvania as soon as it can be finished.—Ellwood (Ind.) Telegram to Indianapolis *News*.

The Pittsburg Valve, Foundry & Construction Co. is building a new foundry.

The Joliet Stove Works, Joliet, Ill., have increased their capital stock to $300,000.

The Cooper, Wigand & Cooke Co. has been incorporated with a capital of $400,000 to manufacture steel castings at Paterson, N. J. John K. Cooke, one of the incorporators is general manager of the Passaic Rolling Mill Co. of the same city.

The Valley Foundry & Machine Works have been incorporated at Fresno, Calif., with a capital of $25,000.

The Anchor Stove & Range Co. of New Albany, Ind., has been organized with a capital stock of $100,000.

The new owners of the Louisiana Machine & Well Works Co., Jennings, La., have reorganized the concern, which will hereafter be known as the Oil City Iron Works Co., Ltd. The capital will be $25,000.

Kemp & Foulk of Williamsport, Pa., will build a new foundry, having double their present capacity.

August Frommer will build a brass foundry at Toledo, Ohio.

Method of Making Rope Wheels.

BY HARRY WILLIS.

Some time ago I had two 6-groove rope wheels to make, 14 feet in diameter with a face 14 inches in width, the arms to be cross-shaped, the general type used in spur wheels. Our usual system of making these wheels has been to make a complete pattern with a 6-inch print projecting on the outside of the wheel to receive the groove cores, made in segments and dried in the usual way, and in due course placed in the mold end to end until the circumference of the wheel has been covered. Doubtless in the case I want to illustrate we would have followed the same practice had it not been for the fact that we did not have a pattern anywhere near the right size and time would not permit the making of one.

After doing considerable thinking and discussing various means for turning out these castings we decided upon the following method which proved very satisfactory and it is our intention of following this up in the molding of all rope wheels of a large diameter which we may have to make in the future. A bed is swept up, as in Fig. 1, on which is bedded a circular plate with level edges and four lugs for lifting, as shown in Fig. 2. After the bed is swept up, all sand is cleared off the top of the plate and a trowel run around the inside edge of the plate to prevent the outer edge of the bed from being broken up when the check-plate carrying the grooved portion of the mold is removed.

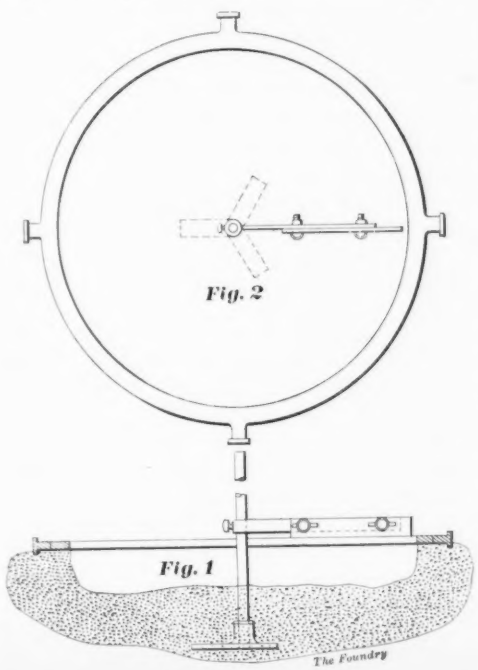


Fig. 2

Fig. 1

When everything is ready to sweep up the mold we procure a segment of the groove pattern extending for about two feet of the circumference. This has two stays fastened by rough hinges, so that they can be turned outwards and thus allow the segment to be drawn inward, without removing screws or disturbing the spindle. The two stays are fitted only around the spindle and are held in position by a thumb screw, A, Fig. 3. Once the correct position for the grooved segment has been ascertained it becomes an easy matter to mold a complete circle of grooves as, by loosening the thumb screw, the segment may be readily drawn inwards after each section is rammed up without the least difficulty.

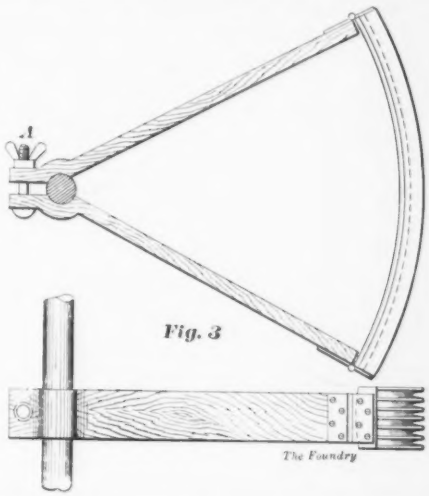


Fig. 3

This class of molds we are in the habit of blackwashing and skin drying with a small fire placed in the center of the mold and the hole covered over with a few pieces of sheet iron. The bottom half of the mold is rammed up in green sand by the aid of a sectional pattern comprising the bottom half of two arms with hub and print attached as shown in Fig. 4. This operation finished we have a complete drag portion of the mold and our next duty to complete the wheel is to form the top part which is accomplished by the aid of two core boxes, one forming the upper rib in the arms and the other making cores filling the intermediate space forming the inside of the rim. The ends of all of the cores, when properly placed form the hub, the long rib in the center of the core making the cross-arm complete, when placed on top of the drag portion of the arms

already finished. The triangular spaces left by the cores are filled in with loose sand and made level with the top of the cores, completing the mold, which may be covered by either a flat cope or a loam plate. In our case we used two shallow cast iron copes, which we turned upside down, rammed them up and leveled them off with a sweep. We then struck three circles,

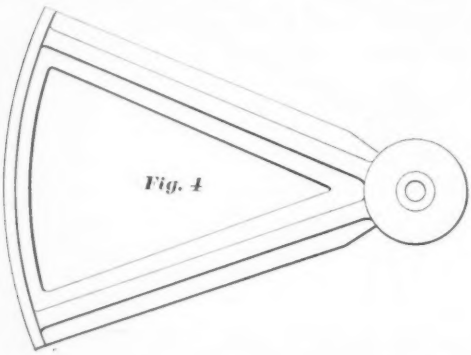


Fig. 4

one the size of the center core, the other the size of the hub and one showing the outside diameter of the wheel. The gates were next placed in position, the main core centered, the two copes turned over and lowered on the mold. This whole job, with the exception of the cores, was completed and cast by one molder and an apprentice in about twenty-three hours' working time.

I think there are several advantages in the method of molding such castings as here described. First, there is a saving in the cost of a pattern, and the room required to store this, particularly where a foundry does not have too much room. Then again, in the actual molding of the wheel if we had the complete pattern and bedded it in the floor and rammed it up in the usual way, this would require as much labor as was expended in this particular instance. There is also, I believe, considerable saving in the making of cores. It would require something like 30 segment cores to complete the grooved portion of the casting and when we consider the cost of sand and everything connected with the making of such cores and the fitting, which, as a rule, has to be done on jobs of this kind, it is evident that considerable labor is saved. Again, any molder who has made castings of this kind with segment cores will agree that the grooves are always more or less irregular at the joints of the cores and this necessarily means an increase of labor in the machine shop. By following the method of molding here described the grooves are perfectly true.

Treatment of Chills.

There are a good many different kinds of "chills" used in the foundries of the country, some of which so-called chills would better be designated as iron cores, because their essential purpose is to take the place of sand cores. Indeed, sometimes they are not intended to act as a chilling agency at all, but merely to make holes in the castings.

Chills for the various purposes for which they are employed have been in very general use for many years; and it would seem as though the rules for preparing them for their several uses ought to have become thoroughly fixed and generally known. Nevertheless, there are many foundries where experience in their use is very limited, and where the practice is crude, and, in results, wasteful.

The required treatment of chills in preparing them for use depends upon the service demanded of them. Chills for plow molds are simply coated with kerosene oil, flirted on with a paint brush, after the mold is finished and ready to "close." Other kinds of oil are used by some makers, though I think nothing superior to the above. Tallow is quite as good, however, though this must be applied by rubbing it on the surface while the chill is hot, and spreading by means of a rag, which thoroughly distributes the grease and removes any excess. In the use of kerosene, any excess is removed by evaporation and absorption by the sand forming the borders of the mold.

Any kind of waste oil or grease is good enough for treating chills used in making plowshares and for other simple purposes, where great resistance to heat and very smooth surfaces are not required.

Chills that are used instead of sand cores usually require a very different preparation from that described above and frequently challenge the ingenuity of the inexperienced in their successful employment.

Here, again, much depends upon the varying shapes, proportions, etc., of the chills, and the mechanical and heat conditions encountered. An apparently insignificant difference in one or both of these may account for the satisfactory results from a given treatment in one foundry that utterly fails in another.

In simple cases, where there is ample taper to the chills, they may be oiled and then coated with dry parting sand. Where the taper is slight, I prefer to use painter's japan instead of the oil, as it is a better binder for the coating of sand. And, in my experience, the castings

are not nearly so apt to blow where japan is used.

The sand used for coating the chills should be of a very fine grade, as coarse sand will not adhere so perfectly, and will consequently leave unprotected spots on the chill, and the chilled surface of the casting will be comparatively rough.

Fine, dry sand furnishes a smooth, continuous coating of practically uniform thickness, and, when bound to the chill by a previous coat of japan, affords an effective protection against the molten iron.

The greater cohesive quality of japan as compared with oil not only enables it to hold the sand coating intact, but causes it to adhere to the chill without "running" or flowing, as in the case of oil.

All of these features are of great importance, and I dwell upon them for the purpose of emphasizing the superior value of japan in this particular instance.—E. H. Putnam in *The Tradesman.*

Notes from Various Sources.

The Galena Iron Works have been incorporated at Galena, Ill., with the following officers: President, F. H. Ives; vice president, H. M. Stryker; secretary and treasurer, H. L. Heer. The company have leased one of the factories previously used in the manufacture of wire fence. The present buildings will be converted into machine shops and in the early spring a new foundry will be constructed adjoining the main machine shop.

The J. D. Smith Foundry Supply Co., of Cleveland, O., have on hand several thousand small notebooks, made up in the form of a "daily reminder," or diary, which they are anxious to give away to people connected with the foundry trade. Ask for one.

The Norwalk Mfg. Co., of Norwalk, O., have been incorporated to succeed the Norwalk Foundry & Machine Co. Capital stock, $50,000. Incorporators: W. H. Price, E. A. Stevens and A. M. Beatty.

The Philadelphia Pneumatic Tool Co., of Philadelphia, have issued a pamphlet dealing with "The Care and Use of Pneumatic Tools," of which a copy will be mailed upon application. It is of general interest to the trade and we quote a part of the suggestions offered in regard to pneumatic rammers, as follows:

"In using foundry rammers a little attention should be given to the piston and packing to see that no air escapes, or on the other hand it is not so tight as to prevent the free working of the tool.

"Do not attempt to hold a hand rammer at arm's length, downward, with stiff elbows. If you do it will shake you considerably. Hold the rammer as lightly as possible on the open fingers in front of you with bent elbows. The tool will be found to practically support itself when running, and it will only be necessary for the operator to guide it about the work.

"A little practice will indicate to you the proper distance to hold the tool above the work so as to get the best results. Do not let the piston hit the cylinder inside nor hold the tool so low that full strokes cannot be made.

"Do not lay a rammer down on the foundry floor where dirt and sand can get into the throttle handle and other parts. Lean it against a flask or something when not in use, or hang it up."

The Tyrone Foundry & Machine Co., Tyrone, Pa., are building an addition to their foundry 30x100 feet, which will increase the capacity of this part of their works about 75 per cent.

From Maris Bros., crane makers, Philadelphia comes a very fine booklet dealing with the special features which have made Maris hand and electric traveling cranes popular. The manufacturers dwell with special emphasis on the small amount of headroom these require for operation and the ease and precision with which they are controlled by a single individual, from the floor. Many other details, in which crane users are interested, are taken up. The booklet is mailed free upon application.

The Williamson Brothers Co., of Philadelphia, Pa., are about to erect a foundry plant covering an area of 227x329 feet, consisting of a light casting room, 55x150 feet; floor molding room, 55x208 feet, together with two three-story buildings to be used for cleaning, sorting, shipping and storing castings and patterns.

The Port Huron Air Tool Co., Port Huron, Mich., are mailing to the trade a neat catalogue describing their compressed air motors, motor hoists, pneumatic jib cranes and other air tools manufactured by them. A copy will be mailed free of charge to interested parties.

The Cambria Foundry & Machine Co., are preparing to erect a new foundry at Meadowvale, near Johnstown, Pa.

The Bowler Foundry & Machine Co., has been incorporated at Cleveland, O., with a capital stock of $500,000. A new plant with adequate shipping facilities will be built and a specialty made of heavy castings. W. C. Bruce is president and general manager and N. P. Bowler vice-president.

The Northern Engineering Works of Detroit, Mich., have issued a new crane catalogue which shows the large variety of cranes manufactured by this company and fully illustrates the various types. Among the most prominent are three, four and five motor electric travelling cranes of capacities from three to fifty tons for foundry service, and hand power travelling cranes, jib cranes, and locomotive cranes of standard design. The catalogue is profusely illustrated and will be sent free on request.

The Gehring & Stephens Mfg. Co. has been organized at Pittsburg, Pa., to operate a machine shop and brass foundry. Joseph Gehring is president and Albert J. Stephens secretary and treasurer.

A very finely illustrated pamphlet, showing installations of the "A. B. C." fan system of heating and ventilating in foundries and other industrial establishments, has recently been issued by the American Blower Co., of Detroit, Mich. Among the plants thus equipped we note those of the Westinghouse Machine Co., at East Pittsburg, Pa., and the Michigan Malleable Iron Co., Detroit, Mich. A copy of this publication may be had for the asking.

The North Pittsburg Foundry Co., recently organized, is building a plant at Anderson Roads, Pa. (Ethel Landing P. O.), which it is expected to have in operation early in the year. The Pittsburg office of the company is 601 Keystone Building.

The Pedrick & Ayer Co., manufacturers of air compressors, air hoists and other pneumatic appliances, have removed from Philadelphia to their new works at Plainfield, N. J., which have been provided with modern equipment throughout. The selling offices of the company will remain at 85, 87, 89 Liberty street, New York.

Neiman, Stokes & Co., who for some time have operated a foundry at Reading, Pa., have nearly completed a new plant at Hamburg, Pa., which will mainly produce light castings.

R. MacKellar's Sons Co., of Peekskill, N. Y. announce that they have purchased a deposit of fine white soapstone and a mine of excellent graphite which will be opened and worked on an extensive scale.

The Ideal Stove & Foundry Co., of Daleville, Ind., have increased their capital stock to $40,000.

George Robertson is making arrangements to start a foundry at Ames, Iowa.

The Garden City Sand Co., of Chicago, have issued a very interesting booklet describing the various grades of molding sand they are prepared to furnish. These include sand for all classes of castings, in addition to which core sand of special quality is shipped to the trade. The company invites the founders to assist them "in keeping their office boy busy," by sending for samples, which will be sent free, as will also the booklet.

The United States Foundry & Sales Co., will shortly begin the manufacture of stoves and furnaces at South Norwalk, Conn. The new concern will occupy the plant of the late Richardson & Morgan Co.

The Phosphor-Bronze Smelting Co., of Philadelphia, will mail to interested parties a booklet giving information in regard to "Elephant Brand" Phosphor-Bronze and other alloys.

The Cummings Iron Works & Supply Co. has been incorporated at Walterboro, S. C. The officers are: O. M. Reed, president; G. W. Raysor, vice president; W. J. Fishburne, secretary; C. T. Cummings, treasurer and manager.

Abendroth Bros. of Port Chester, N. Y., have begun the erection of a new foundry, which will be devoted exclusively to the making of soil pipe and fittings, leaving the present plant for stove and heater castings.

Additions to the plant of the Allentown Foundry & Machine Co., Allentown, Pa., are being considered.

The Platteville Iron Works have been incorporated to do business at Platteville, Wis. The capital stock is $60,000 and the manufacture of mining machinery will be made a specialty. J. A. Rogers, a foundryman of Neosho, Mo., is one of the chief stockholders.